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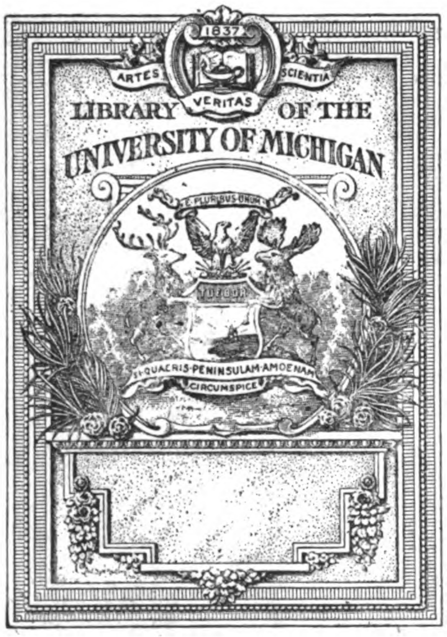

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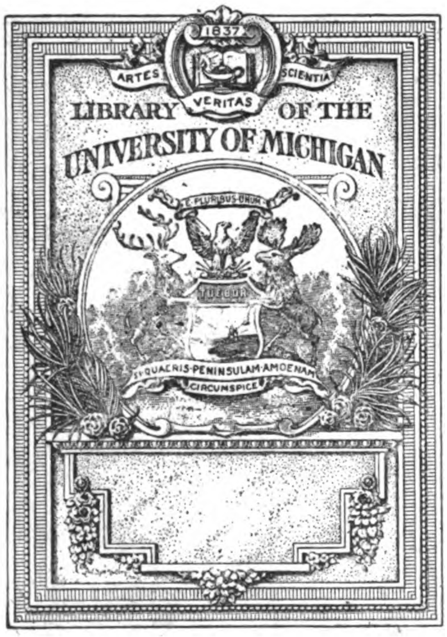

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Electrical Engineer.

A Weekly Review

OF

Theoretical and Applied Electricity.

VOLUME XVII.—1894.

(January to June.)

NEW YORK:
The Electrical Engineer,
203 Broadway.

Alphabetical Index of Contents.

A denotes Articles. **Ax** denotes Abstracts and Extracts. **E** denotes Editorials. **L** denotes Letters to the Editor.
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THE
Electrical Engineer.

Vol. XVII. JANUARY 3, 1894. No. 296.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—I.

BY

Mary A. Henry

WHILE reading Miss Henry's remarkable presentation of her father's great work in connection with the Electric Telegraph—remarkable in the power she has shown in grasping the essential features of her father's labors—I was reminded of my first interview with Joseph Henry. One morning he came into my laboratory at Cambridge, and, after I had shown him various pieces of scientific apparatus, he stood before an electro-magnet which was working a relay and looked long at the magnet, and then at the battery which was coupled for quantity, and remarked in a quiet tone, as if half to himself, "If I had patented that arrangement of magnet and battery I should have reaped great pecuniary reward for my discovery of the practical method of telegraphy."

Miss Henry can speak with authority upon her father's aims and labors, and the conclusions she draws from his conversations and from his notes and letters are in consonance with the belief which has been steadily growing, that Joseph Henry invented the essential features of telegraphy.

JOHN TROWBRIDGE.

THE ELECTRO-MAGNET.

Joseph Henry.

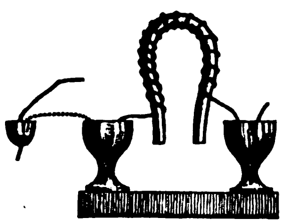
IN the civilized world is there anything which in this day contributes more to the comfort of man than the electro-magnet? Strike it out of existence and the electric telegraph would die. Its great network of wires would be as useless as the curious system of nerves which carries the message of the brain to the finger tips is useless when that mysterious principle which constitutes the life of the human being has departed. The telegraph gone, distant countries would unclasp hands, as it were, and the wide ocean roll again between. The eager world would be struck dumb in the midst of its innumerable political, commercial and social relations; or, rather, would be sent back to the stammering old time when months intervened in the exchange of thought, now possible in an hour. But not alone as the soul of the telegraph would the loss of the electro-magnet be felt; hardly a moment's thought is needed to realize the place it has gained, the importance its failure to meet the demands made upon it would be to the world. How did it come into existence—this electro-magnet? Perhaps, considering the importance of the subject, it may bear to be not merely a twice-told, but an oft-repeated tale.

What is a magnet? Our acquaintance with it began in our childhood : as a piece of steel endowed with a mysterious attractive power, it was among our toys; many a time have we held it over a pile of needles and laughed to see them leap to meet it, or with it we have drawn our little boats from the farther side of a mimic sea. How did it receive its name? It is pleasant in imagination to travel far away through the beautiful islands of the Ægean sea to the shores of Asia, and to believe in the romantic story which tells us that a Greek shepherd, Magnus by name, wandering over Mt. Ida with his sheep, found his crook suddenly and powerfully attracted by a mass of iron ore, and so attached his humble name to the loadstone or natural magnet. But fancy must yield with reluctance to the more prosaic assumption now generally adopted, that the name was derived from Magnesia, in Lydia, where the ore was first found.

For the word *electro* we must not only come down the mountain, but descend the stream of time to about five hundred years before Christ; then we must follow the undulations of the Ionian coast, to find, at the mouth of the river Meander, the city of Miletus. Walking her streets at this time, caring little for her magnificence or for the wars in which she was engaged, save to induce peace, was Thales, one of the seven wise men of Greece. Among the objects of trade in the magnificent city was the yellow amber; not an object of indifference to the philosopher, although as yet only of frivolous use as an ornament. Its color no doubt delighted his eyes but it had a deeper interest for him. Rubbing the stone one day—perhaps to make its yellow tint clearer—he found that he had endowed it with a curious power: a loose feather flew to meet it. This power seemed to Thales miraculous. He imagined there were spirits in the amber and so came to think that everything in the universe must be pervaded by spirits. Thus electricity was discovered, and it received its name, long afterwards, from the Greek word meaning amber.

It was at a very early period that the loadstone or natural magnet was discovered. Very early too was known the remarkable power it possesses of transmitting its properties to hard iron or steel when these bodies are rubbed, or even touched by it. Thus came into being the steel magnet—possessing not only the same power of transmitting its properties but also a quality lacking in the ore; turning north and south, when free to move, in obedience to the great magnet, the earth, it had a directive power which more than two thousand years before the Christian era directed the traveler over the land, as later it was to guide the mariner over the sea. From this remote period it is a long flight down the ages until in England, in the cabinet of the self-taught shoemaker-philosopher, Sturgeon, stood the first electro-magnet; that is, the magnet made by electricity.

Of the deepest interest to the scientific world was this little instrument. It consisted of a small bar of soft iron bent into the form of a horse shoe, with a spiral of wire wound loosely around it, the ends of the wire dipping into two cups of mercury. When into these cups the wires from a galvanic battery were also dipped, an electric circuit was formed and the electric current, passing through the spiral of wire, rendered the soft iron bar magnetic. It was very feeble, this magnet; it required a large battery to give it any strength. What advantage could it boast over the steel magnets which had served the world so many years?



Sturgeon's Magnet.

Some of these were very powerful; one in London at this time belonging to the Royal Society lifted one hundred pounds. These magnets were all permanent: steel when endowed with magnetism retains it; not so soft iron. This bent bar of Sturgeon's was a magnet only while the electricity was circulating through the wire around it; in this lay its advantage: *it was a magnet, or not, at the will of man.* It was not merely as a scientific fact that the world turned to it with such eagerness; it renewed an old hope that electricity might be made the messenger of man. The story of the electro-magnet is but a part of the story of the electric telegraph; we may not tell the one without reference to the other.

We cannot go back far enough in the history of man to find a time when the idea of the distant communication of intelligence did not exist. In the earliest childhood of the race even, beacon fires proclaimed from hill to hill tidings of weal or woe. In those early days man looked up with dread to the lightning, thinking it "the eye-flash of an angry god," not dreaming that it was the manifestation of the agent which was to satisfy his long-cherished desire for distant communication with his fellowman, that the very genius of the storm was one day to serve as his messenger.

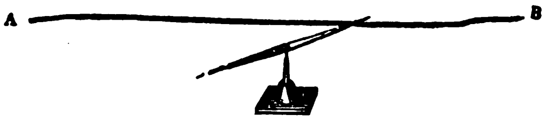
It is interesting to know that Hauksbee of England in 1705 was the first to suspect the identity of lightning and electricity. He produced a thunder-storm in miniature by drawing a piece of amber swiftly through a woolen cloth. He says "a prodigious number of little cracklings were heard, every one of which produced a little flash of light. This light and crackling seem in some degree to represent thunder and lightning." As man learned in various ways, by the rubbing of amber and other substances, to excite electricity, and learned also the value of the force thus produced, also that the electrical influence could be transmitted through several hundred feet of wire, there came to him the conception that by the friction of his machines he might, as Aladdin by the rubbing of his lamp, summon the slave of his will which was to serve in the transmission of intelligence. The first attempts to use electricity for this purpose began in 1753. Who was the first to suggest the idea it seems difficult to determine; it was such a natural idea after the experimental results which had been obtained that it probably occurred to many minds at the same time, and it is only surprising that it was not conceived earlier. We may not here notice any one of the efforts in this line founded thus on frictional or static electricity; they form one of three distinct, although overlapping, eras in the history of the telegraph. They had a measure of success. They were very interesting from a scientific point of view and they served certain ends, but they did not give the telegraph to the world.

[By the telegraph I mean here that system or combination by which mechanical effects can be produced at *great distances*—through seas, over continents—and I use the term in contradistinction to the many attempts towards this result, made at various times and in various places which if successful were so only in a limited degree, because the natural laws which control electrical action were undiscovered or unknown. Will the reader be so kind as to take especial notice of this remark; it is necessary for the proper understanding of my story.]

In Bologna, in the year 1753, a "religious youth of fourteen years was dreaming of church service, discouraged by his friends; while on the shores of Lake Como was playing a boy of eight;" these two were destined to make the discovery which was to form the second era in the history of the telegraph. In 1789, a dead frog's leg hanging upon a copper hook and kicking as though it were alive whenever the sportive wind blew it against an iron balcony—electricity at work, in what seemed almost the enjoyment of a jest—revealed to Galvani that by chemical action, as well as by friction, the genius of the thunder-storm might be evoked. Volta followed with his "couronne de tasses" and thus came into being the Galvanic or Voltaic battery, bearing the names of both men. So general and profound was the interest excited that Napoleon Bonaparte invited Volta to Paris, witnessed his experiments with the instrument in the presence of the National Institute, and loaded him with decorations.

More eager now grew the hope of means of distant communication. The electricity of the machine, that is, the electricity produced by friction, had answered for this purpose only in a very limited degree; but this battery,—might not its long wires be extended indefinitely? Might not this current of Volta's, easily excited, easily set at rest, by the mere making or breaking of the contact of those same long wires, at last be the messenger so long desired? Of the many efforts in this direction, led in by Sœmmering of Munich, we may not speak. Could we follow their fortunes, now in one country, now in another, we would find that, however ingenious, sooner or later they all ended in the same difficulty, viz.: *the failure of the electric force with increase in the extent of the conducting wire of the battery.* It was but a question of time, or rather of distance; each new effort met the fate of its predecessors. For a while the electric force seemed to lend itself to this service, only to escape and laugh, as it were, at the efforts of the impotent creature, man, to bring it under restraint.

We turn now again to the electro-magnet. In a former article we tried to tell, in these pages, how the world found out that electricity could produce magnetism; step by step, from Oersted swaying his needle through the influence of the electric current, down to Ampere magnetizing needles in a glass case by means of electricity; we come back to 1824–25, to the bent iron bar in Sturgeon's cabinet and to the interest it excited. Then indeed the telegraph seemed a thing of the near future. There was not only the wonderful Voltaic battery, there was this magnet ready to respond to the will of man; could it not be made thus to respond at a distance? Surely the desire of the world would now be accomplished!



OERSTED'S NEEDLE.

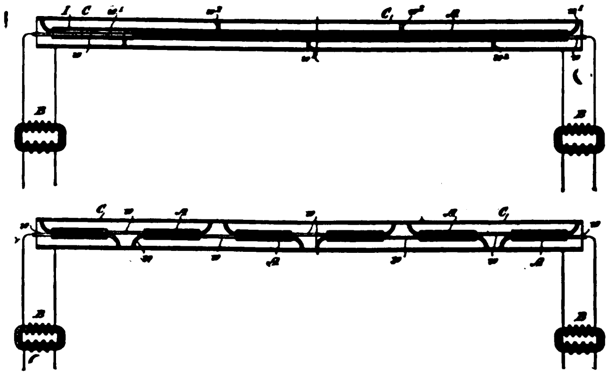
Barlow, a distinguished mathematician and engineer of England, essayed the practical experiment with the new instrument, while Europe waited, we might say, with bated breath, in confident expectation for the result. What was it? Again a disappointment. We will let Barlow speak for himself. "The details of the contrivance are so obvious, the principles so well understood, that there is only this one question which could render the result doubtful. *Is there any diminution of effect by lengthening the conducting wire?* I was therefore induced to make the trial, but *found such a sensible diminution with only two hundred feet of wire as at once to convince me of the impracticability of the scheme.*" It could not be possible! The experiment was repeated in various ways, in the same year, 1825, and in the following year, but with like result; each experiment confirmed the reluctant conclusion that after all the brilliant discoveries which had excited such eager expectation, an electro-magnetic telegraph was an impossibility. Since Sturgeon's magnet, as well as Volta's battery, had failed, there appeared to be no means of obtaining sufficient electrical force to act at a distance.

Had the hope of the telegraph indeed ended, and in disappointment? *For want of sufficient electric force the* *telegraph is an impossibility;* such seemed the verdict of the science of Europe, and with it we turn to America. Very brilliant was the old world of science, at that day represented in the line of physics by such men as Hansteen, studying the magnetism of the earth, Gay Lussac and Biot invading even the blue air in the search after the magnetic forces, the immortal Arago, the brilliant Ampere,—we can only mention a few of the names which, enrolled upon the lists of fame, have come down to us as household words. In America, to oppose that eminent array of veterans in this particular field of science there was only young Henry, in the Albany Academy.[1] He dared to brave the electric force and demand of it greater energy. Mr. E. N. Dickerson says of him—"He was but a youth and ruddy and fair of countenance, armed only with a simple sling of his own construction and pebbles from the brook of nature, but he was equal to the trained warriors of maturer growth and superior armor, waging war against the Goliath that guarded the unexplored regions of nature's secrets; and like the great king of Israel, after the hunt of the battle was over, he came to be leader of the hosts who once had been tending only a few sheep in the wilderness."

THE REED INDUCTION SYSTEM OF TELEGRAPHY.

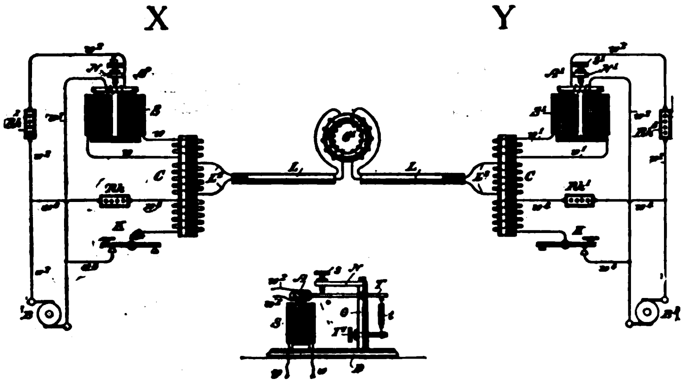
In the operation of telegraph lines the amount of energy required for the transmission of signals is of little account as compared with the importance of securing high speed. Thus, were it possible to increase the commercial capacity of an Atlantic cable ten times by the continuous use of one thousand horse power in current, instead of that of a few cells of battery, it would be an economical step on the company's part to substitute the power plant. The static capacity of long cable, under existing conditions, however, prevents the possibility of transmitting any large quantity of energy or of making variations travel with the desired speed.

Some of the most distinguished electricians of the day have endeavored to overcome this difficulty. About twenty years ago Mr. Edison proposed to do away with static capacity almost entirely by breaking up a long line into shorter circuits and employing induction coils; but his system was confined to a dot and space code, and the action of the armature was unreliable. Prof. S. P. Thompson's method of transmitting a current the whole length of the line and then overcoming static retardation distributively, is still fresh in the minds of those who listened to his paper at the recent Electrical Congress or read the published reports of the proceedings;[2] but while furnishing valuable food for thought, and much that was theoretically novel and valuable it seems to be open to several practical and mechanical objections. Other inventors have devised ingenious systems to overcome the difficulty but none has yet proved useful in practice.



FIGS. 1 AND 2.

Mr. C. J. Reed, of Philadelphia, has recently worked out a method embodying principles which seem to meet the requirements of the case and in a manner distinctly novel and to all appearances practically available. In his system he employs a true alternating current successively induced in separate metallic circuits which may be entirely insulated from one another. This enables him to use high electromotive force and transmit large quantities of energy and reduce the static retardation practically to zero. At the same time almost any receiving instrument may be used, as it is only necessary to provide it with a local means of maintaining the temporary effects of an inductive impulse until the reverse inductive impulse arrives to destroy it.



FIGS. 3 AND 4.

In the accompanying illustrations, Figs. 1 and 2 show the form of cable employed. In Fig. 1, *w* and *w'* are insulated conductors lying side by side throughout the entire distance between two stations, the conductor *w* being connected at each end of the line directly to the terminals of the converters B and to the outer metallic coating C, while the conductor *w'* is connected at both ends directly to the metallic casing. w^2 w^2 are insulated branch conductors located at stated distances apart, those on the lower side of the drawings connecting the conductor *w* directly with the outer metallic casing C while those on the upper side and intermediate between those described connect the conductor *w'* with the metallic casing. I is a metallic sheathing of iron wound in layers around two parallel conductors *w* and *w'*, constituting an inductive field around them.

When an impulse is set up through the primary of, say, the left hand converter B, a secondary or induced impulse will be set up through the conductor *w* and the first one of the short conductors w^2 returning through the outer casing C, thus inducing in the first section of the conductor *w'* an impulse which in turn induces in the next succeeding section a corresponding induced impulse; and so on through the series until the final impulse is effected through the conductor *w* and its connections through the coil of the right hand converter B which in turn induces the working impulse in the receiving instrument.

In another form shown in Fig. 2 the continuous conductors are replaced by a series of short conductors *w w*, the ends of which project past each other in alternating order and are connected to the outer casing C, the parallel or inductive portions of the circuits being surrounded with iron wire, as shown at A, while the intermediate portions between these casings form the conducting parts.

In Fig. 3 are shown two main telegraph stations X and Y joined together by an intervening cable consisting of an internal conductor L^2 insulated from a surrounding conducting shield L, the two portions constituting the direct and return conductors and including in their circuits at the opposite stations the secondary coils of two converters C C, and the similar coils of an intermediate converter C′. B and B′ represent two direct current dynamos, and K and K′ the transmitting or signaling keys at the transmitting stations, connected in local circuits with the generators through the primaries of the converters C and C′, rheostats Rh and Rh' and conductors w^3 and w^4.

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[1] NOTE.—"On the shoulders of young Henry has fallen the mantle of Franklin" were the words of Sir David Brewster. It is true Cox had suggested a chemical telegraph and Hare made many improvements in galvanic apparatus, but no representative of Franklin, in a series of connected experiments, had entered the field of electric science in America, until Henry began his researches.

[2] See THE ELECTRICAL ENGINEER, Aug. 30, 1893.

S and S′ are the receiving instruments connected through conductors w and w' with additional coils on the converters C C. The armature levers A and A′ may be permanently magnetized, or they may be energized by coils included in permanently closed local circuits w^2 w^3, including rheostats Rh^2, Rh^3, so that the influence of the retractile springs t will prevent the armature from being drawn forward under normal conditions (Fig. 4).

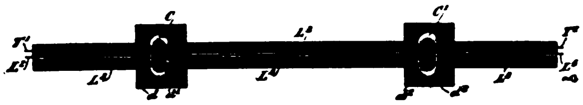


FIG. 5.

When the operator at station X closes the key K an inductive impulse will be set up in the local circuit w^3 of the converter C, which sets up two individual secondary impulses, one in the main line L L² running to the distant station Y and the other in the receiving instrument S, the magnetic effect of which is such as to momentarily increase the pull on the armature A sufficiently to enable the armature lever T to overcome the influence of the spring t and draw it into the forward position shown. In like manner the impulse sent to the distant station sets up in the secondary of the converter C′ an impulse which, acting through the coils C, secondary circuit w' and coils of S′ causes the armature A′ to be drawn into its lower position as shown. Both armatures will therefore remain in their lower position by virtue of their own magnetism after these impulses cause them to be brought down until the key K is opened, when like impulses in a reverse direction cause both armatures to be repelled. Hence for simple inductive impulses, signals may be transmitted, such as the Morse code, in which the elements of the characters are of varying lengths.

In Fig. 5 is illustrated an apparatus for use in cable telegraphy or on long land lines, which consists of a series of converters C C′ located in the body of the cable, the outer surface being of metal constituting a common return circuit for the primaries of all the converters. T′ represents a test line embedded in the cable for detecting breaks.

It will be seen also that the inventor is enabled to insulate all receivers from the main line by several inches of air space and interpose a grounded piece of sheet metal of any size required to prevent the possibility of lightning reaching the receiver. It may also be adapted to telegraphy between moving trains with the same facility as between fixed stations.

The system does not involve the use of a new code or the slightest change in the present one and entails very little expense in changing from the present Morse system, as the same instruments are employed with only a modification of the armature. Another valuable feature is the possibility of multiplying the messages sent by creating similar impulses on a number of lines radiating from the same point. Mr. Reed claims that with his system several hundred words a minute might be sent from New York with an automatic transmitter, and simultaneously received in all the great capitals of the world.

A FRANCHISE has been granted to I. Sparks for operating a local telephone exchange in Santa Fe and vicinity. The poles are erected, and the system will soon be in operation.

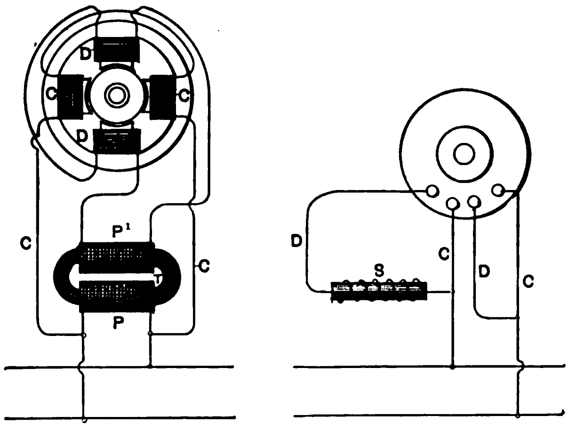
TESLA MOTORS OPERATED FROM SINGLE PHASE TWO-WIRE ALTERNATING CIRCUITS.

THOSE who have followed Mr. Tesla's work in alternating motors will recall that in 1888 he first drew public attention to his new multiphase system of operating alternating current motors, in a paper read before the American Institute of Electrical Engineers, in which he laid down the principles which have since been practically applied in many ways. In this system, it will be remembered, each motor contains two or more independent energizing circuits through which are passed alternating currents, having in each circuit such a difference of phase that by their combined or resultant action they produce a rotary progression of the poles or points of maximum magnetic effect of the motor and thereby maintain the rotation of the armature.

A multiphase system of this kind, however, requires at least three wires for its successful operation, to convey the currents differing in phase, and Mr. Tesla, therefore, early set about to devise means for operating phase motors from the ordinary single-phase alternating circuit, by creating the difference of phase locally at and in the motor. The various ways in which this can be done are described in two patents just granted to Mr. Tesla, which are of special interest at this time.

In all the methods described below, the fundamental idea involved is to pass a single alternating current through both of the energizing circuits of the motor, and to retard the phase of the current in one circuit to a greater or less extent than in the other. The distribution of current between the two motor circuits is effected either by induction or by derivation.

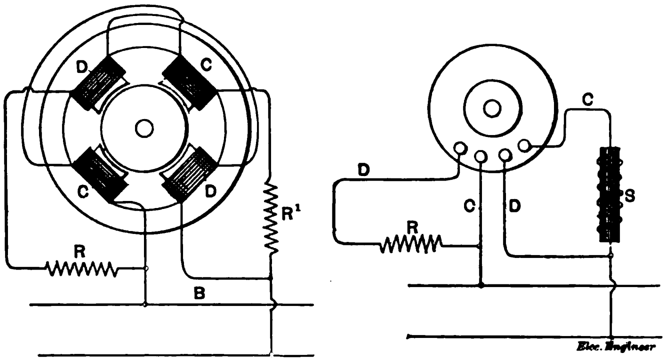
The diagram Fig. 1 shows a motor with two energizing circuits, C and D. One of these circuits, C, is connected directly with the line circuit, while the other set of coils D, is connected up in the secondary circuit of a transformer T. The primary coil P of this transformer, is connected to the line circuit. The alternations of current in the line tend to establish in their passage through the coils C, a polarity opposed to that set up in the coils D, and if the currents in the two sets of coils coincided in their phases, no rotary effect would be produced. But the secondary current developed in the coil P′ of the transformer, will lag behind that in the primary, which lag may be increased to a sufficient extent to practically obtain the same result as though two independent currents were used to energize the motor.



FIGS. 1 AND 2.

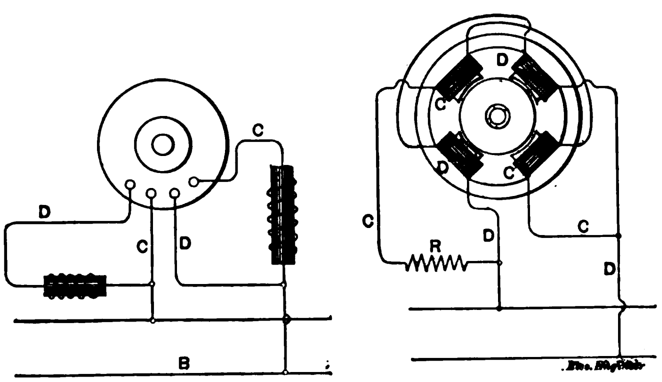
In another form, shown in Fig. 2, the arrangement of the parts is similar to that shown in Fig. 6, except that a self-induction coil S, is introduced into one energizing circuit of the motor. The effect of thus increasing the self-induction in one of the circuits is to retard the phases of the current passing therein to a greater extent than in the other circuit, and in this way to secure the necessary difference in phase between the two energizing currents to produce the rotation of the motor.

In Fig. 3 there is shown diagrammatically a type of motor in which two dead resistances R R′ are included respectively in the energizing coils of the motor. No rotary effect will be produced as long as the resistances are equal, but by varying the resistance in one circuit the retardation of the current in that circuit will be varied and correspond-ing effects produced. For example, a reduction of the resistance in one circuit imparts to the motor rotation in one direction while a reduction of the resistance in the other circuit will produce a rotation in the opposite direction. By means of the two resistances, therefore, capable of variation or of being bodily withdrawn from or inserted in the circuits by simple means, rotation of the motor is secured.



Figs. 3 and 4.

In Fig. 4 a self-induction coil S is included in one of the motor circuits and a dead resistance R in the other. The increased self-induction in one circuit thus produced acts to increase the difference of phase between the current in that motor circuit and the unretarded current in the line circuit. On the other hand, the introduction of the dead resistance in the other motor circuit reduces the retardation and brings the phases of the current in it more closely in accord with those of the unretarded current, thus producing a correspondingly greater difference of phase between the two currents in the energizing circuits C and D.



Figs. 5 and 6.

In Fig. 5, two self-induction coils are shown, one in each motor or energizing circuit. One of these coils is much smaller than the other and has less self-induction or counter-E. M. F. than the other, so that the phases of current will be retarded to a less extent than in the other.

In Fig. 6 the two energizing circuits of the motor are shown connected in multiple arc to the line circuit and in one of these circuits is a resistance R. Assuming the two motor circuits to have the same degree of self-induction no rotary effect will be produced by the passage through them of an alternating current from the line. But if one of the motor circuits, as C, be varied or modified by the introduction of a dead resistance R, the self-induction of that circuit or branch is reduced, and the phases of current therein retarded to a correspondingly less extent. The relative degrees of retardation of the phases of the current in the two motor circuits with respect to those of the unretarded current in the circuit B thus produced, will set up a rotation of the motor.

Finally we may mention another type in which one set of energizing coils is of finer wire than the other or has a greater number of convolutions; or each circuit may contain the same number of convolutions, but composed of different conductors, as, for instance, one of copper, and the other of German silver.

Mr. Tesla has devised still other methods for accomplishing the same purpose, but those described will give a fair idea of the wonderful flexibility of the system.

ELECTRIC HOISTS FOR WHALEBACKS.

A NEW departure is promised in connection with the proposed new ore docks for the whalebacks at Conneaut, O., says the *Evening Wisconsin*. Permanent bridges will span slips 100 ft. wide for the operation of electric hoisting machines. These bridges will be high enough to clear the decks of the whaleback barges by 30 ft. The design is for the steamers, which will tow two consorts each, to put their barges far into these great slips, and then to follow head in, the three passing under the trestle bridges, except that the stern of the steamer, with the stack, will be outside the outer trestle. The cars will then run directly over the hatches, dumping the ore on either side of the slip. The electric hoists require only one man to a car. He travels with the bucket, and dispenses with the signal men and extra engineers and firemen required by the steam hoists. The same power that propels the machinery generates light, so that the stock piles and the holds of the boats can be illuminated and the work carried on by night as well as by day. The method was fully illustrated and described in The Electrical Engineer of Dec. 23, 1891.

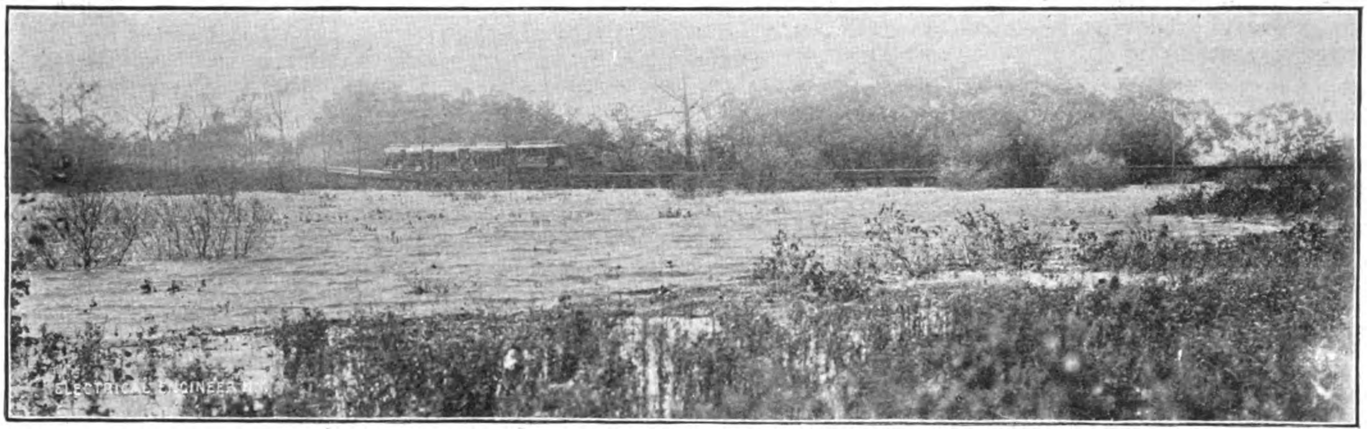
PENNY-IN-THE-SLOT ELECTRIC LIGHTS.

The penny-in-the-slot electric lamps have come into use on the London underground railways this week, says the English *Western Mail*. Trusting to memory, I will say it is two years since the first experimental lamps were put on a few trains. Since then arrangements have been made to fit the lamps to all the trains and the work is now complete. There are four lamps in each compartment. If you want to read, and the ordinary light is insufficient (that is a dead certainty), you put a penny in the slot and obtain an electric light, which lasts you half an hour. If you want more you have to put in another penny. The lamps are conveniently placed at the back of the seat so as to throw the light on the book or paper. They were in immense demand at the outset. Every one wanted a pennyworth of electric light, and I believe people used the trains on purpose to try the lamps. (The apparatus can be seen at the office of The Electrical Engineer.)

ELECTRIC LIGHTS IN HARTFORD, CONN.

Great improvement is expected in the electric street lighting at Hartford, Conn., where President Dunham of the Hartford Electric Light Co. is adopting the Howard incandescent arc system, by which the arc is inclosed in a glass envelope adding enormously to the life of the carbons, giving absolute freedom from flying sparks, and reducing to a minimum the labor of trimming. The Royal Arc Electric Co. of New York, controlling the Howard patents and apparatus, has organized a sub-company in Connecticut, which is to furnish the necessary outfit.

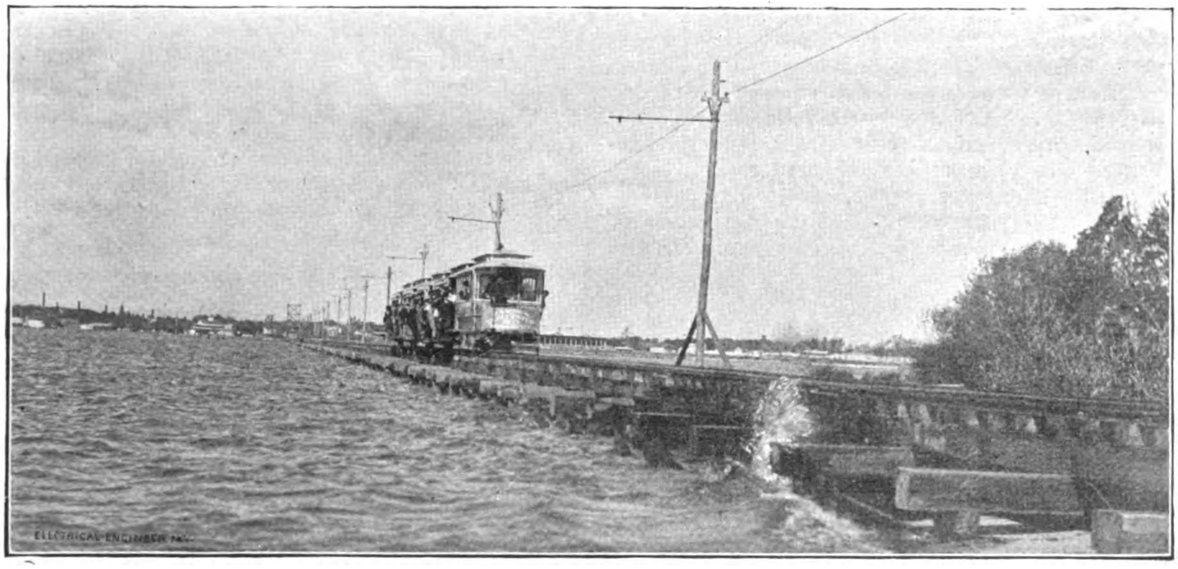
ELECTRIC TRANSPORTATION DEPARTMENT.



ACROSS THE MARSHES: MOTOR CAR, FOUR TRAILERS AND 500 PASSENGERS.

AN AMPHIBIOUS RAILWAY—THE CAMDEN, GLOUCESTER AND WOODBURY.

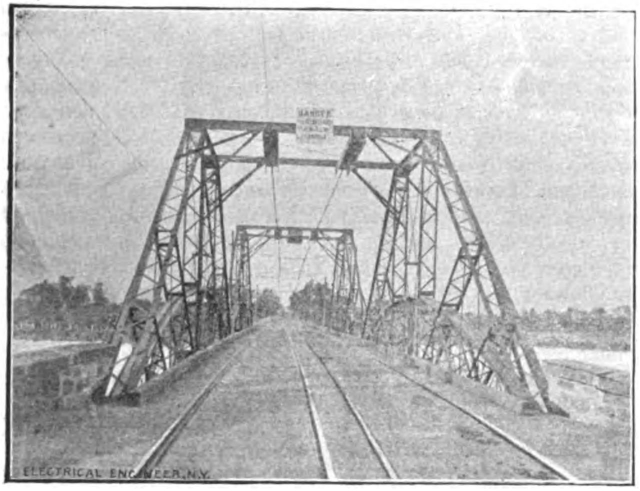
NEW JERSEY along its eastward front is so thorough a blending of sea and land that one is always a little in wonder why the Dutchmen who settled on rock-ribbed Manhattan did not endeavor rather to make their home among the sand dunes and mud banks that stretch south from the Kill von Kull to Cape May. Probably they were rather weary of their job of canal digging and pile driving in old Europe and found more pleasure in a change of occupation. They cannot well be blamed, but New Jersey was too good for other people to neglect, and in these later times, with the aid of the electric railway, the outermost of her shifting sands are being converted into profitable farms and bright summer resorts. Where a dyke would have been thrown up, the modern equivalent is a railway embankment with a trolley line on top of it.



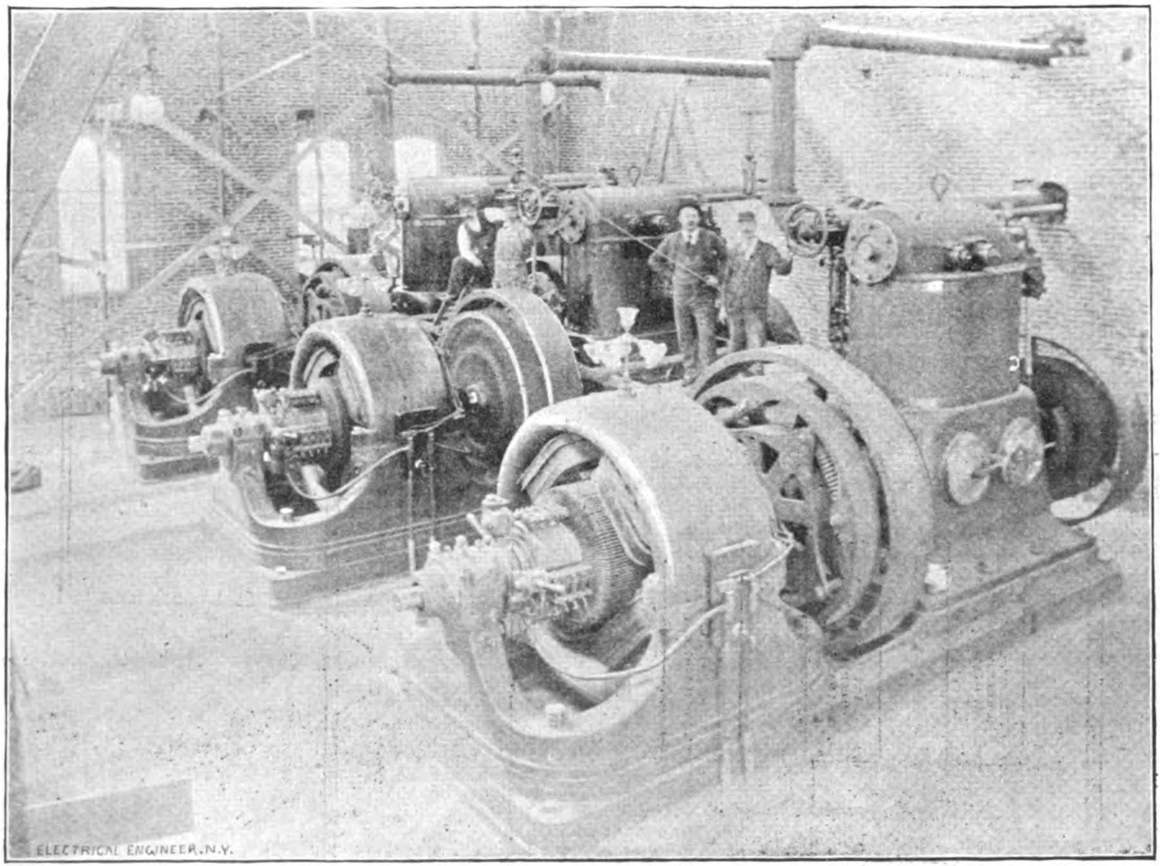
TRAIN OF FIVE CARS CROSSING TIMBER CREEK TO GLOUCESTER.

AT THE DRAW, TIMBER CREEK.

Reference has already been made in THE ELECTRICAL ENGINEER to some of these coast roads in New Jersey, and the coming year will witness several additions to the number. But perhaps the most striking of all is one about which least has yet been said, and as it is very nearly all in operation now, a description will be timely. While it is not exactly a coast road, it is only bald accuracy to speak of it as amphibious, as wallowing in salt water where fresh is not handy. This road is the Camden, Gloucester and Woodbury Railway, built for the company of that name by the Complete Electric Construction Co., of New York city. The three places that give the road its name may be regarded as suburbs of Philadelphia, but have other claims to distinction and liveliness, particularly Gloucester, to whose race track hie the Quaker youth and whose planked shad is a dainty that men have been known to travel three thousand miles in quest of. Rumor has it that at least one American Minister has resigned his embassy in order to enjoy Gloucester planked shad again. If it was not that brought him home, it must have been that other evolution of the spit—"rotation in office." The illustrations that accompany this brief sketch will give an idea in "water color" of what has been attempted and accomplished on the road as it runs across the Jersey bayous connecting one prosperous community with another in a way possible only with the light and flexible trolley system.

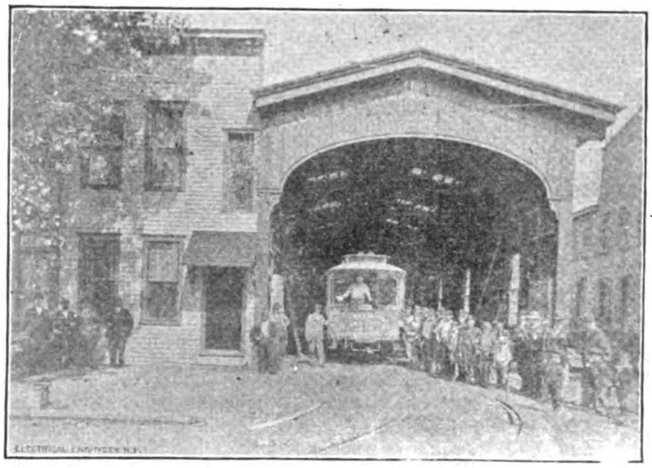


An Old Bridge Cantilevered for the C. G. & W. Road.

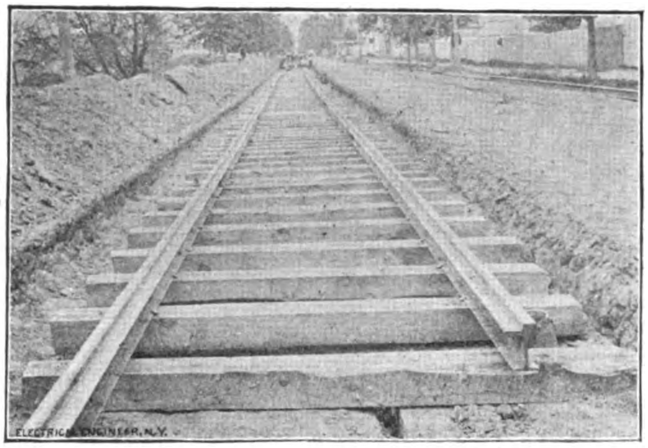


Westinghouse Generating Plant, C. G. & W. Electric Railway.

The Camden, Gloucester & Woodbury Railway Co. have a road which comprises about 5 miles of double track and 5 of single between the places named. The five miles of double track run through the two cities and have 80 pound Johnson girder rail paved up to; while the 5 miles of single are laid with 60 pound T-rail, supplied by the Pennsylvania Steel Co. There are practically no grades worth mention, but on the single track there are six turnouts. Nor are the curves serious; there are eight in all, with a radius of an average of about 50 feet. The line construction is on the cross suspension plan except on the trestles, and the wiring allows for only 2 per cent. loss. The feed wire is No. 0000, the service wire No. 0, hard drawn copper, and the span



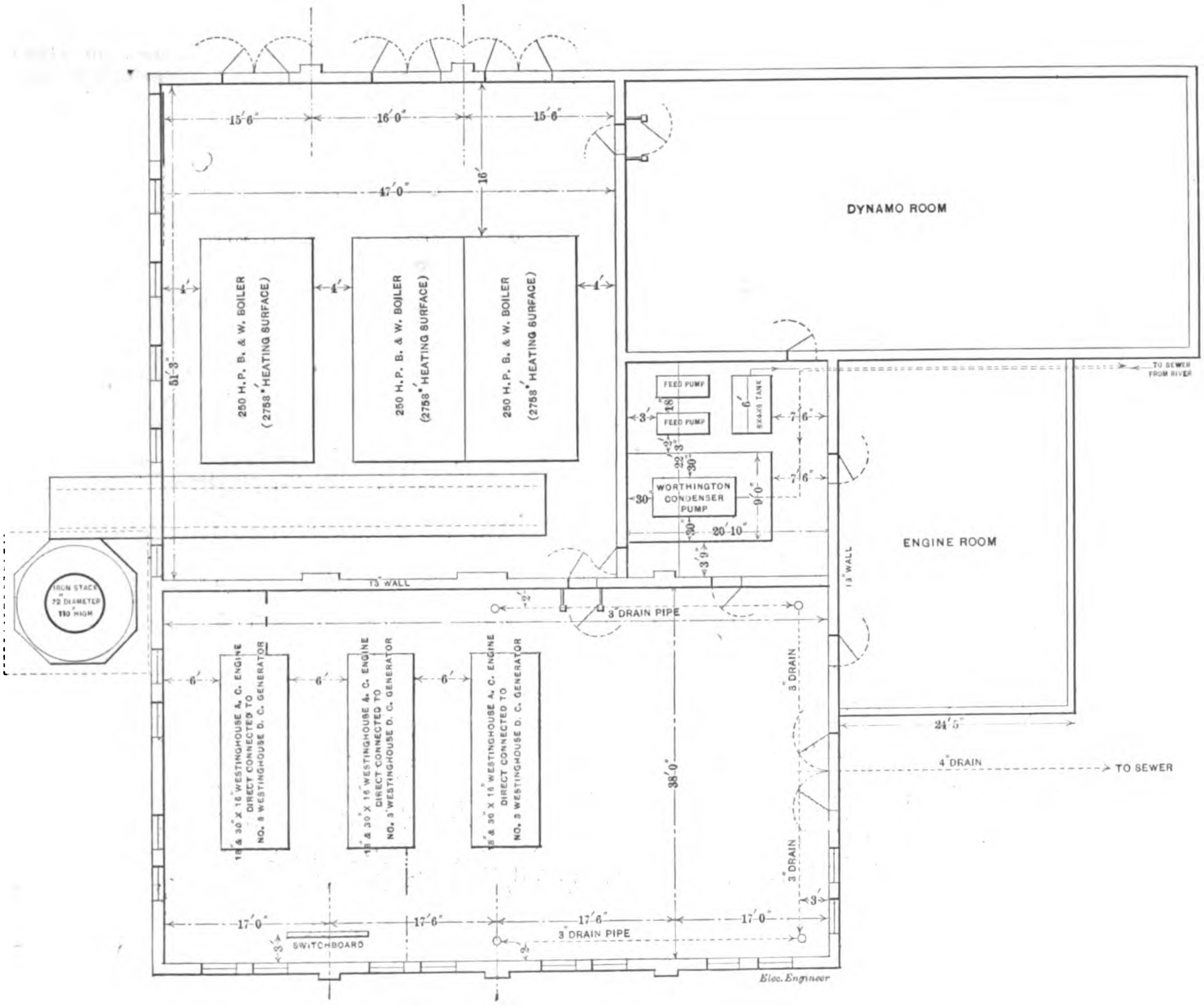
Car Barn, C. G. & W. Electric Railway.



Example of Track Construction, C. G. & W. Electric Railway.

wire, ½ inch steel. The rails are bonded with No. 0 iron bonds, and frequently grounded, the water courses being liberally availed of for the purpose, by means of a rail dropped into them. The road is remarkable for the extent of its trestle work, which is, all told, no less than 3,730 feet long. There is one stretch that has as much as 2,480 feet in it, another of 900 and another of 350. The longest piece has in it a drawbridge with 138 feet swing, and the circuit is maintained intact by means of a heavy Roebling submarine cable under the draw. The road also crosses bits of open sandy country and in one place cuts deep through a mile of wood. The illustrations show the strength of the construction, as in two of the pictures—that of the marshes and that of the trestle across Timber Creek to the Gloucester race track,—the train consists of one motor car and four trailers, having on board a densely packed crowd of 500 passengers. It need not be supposed, however, that the allurements of the racecourse alone explain such travel. Camden City has a normal population of 65,000; Gloucester, of 10,000; and the beautiful suburb of Woodbury, about 4,500; and as a matter of fact, the road is the only outlet for travel to the Atlantic section of South Jersey. Hence the necessity for heavy, solid work, and for such reinforcement as is shown in the cut of the bridge that has been cantilevered on top of the old construction, to secure proper stability.

The power plant for this interesting road comprises three boilers of Babcock & Wilcox make, of a total of 1,200 h. p. furnishing steam to three Westinghouse compound engines direct connected, 250 h. p. each, driving Westinghouse generators of equal capacity. The iron stack is 6 feet in diameter and stands 110 feet high. The power house is of brick and iron. A noteworthy feature is that this is in reality a combination plant, as the Gloucester Electric Light Co. has its station in a wing. This lighting plant


15′ 6″
16′ 0″
15′ 6″
47′ 0″
16′
51′ 3″
4′
4′
4′
250 H. P. B. & W. BOILER (2758′ HEATING SURFACE)
250 H. P. B. & W. BOILER (2758′ HEATING SURFACE)
250 H. P. B. & W. BOILER (2758′ HEATING SURFACE)
DYNAMO ROOM
FEED PUMP
FEED PUMP
18″
3′
6′
6×4×6 TANK
7′ 6″
7′ 6″
22″
3″
30″
WORTHINGTON CONDENSER PUMP
30″
9′ 0″
20′ 10″
3′ 9″
TO SEWER FROM RIVER
IRON STACK 72″ DIAMETER 110′ HIGH
13″ WALL
13″ WALL
ENGINE ROOM
3″ DRAIN PIPE
6′
6′
6′
18″ & 30″ X 16″ WESTINGHOUSE A. C. ENGINE DIRECT CONNECTED TO NO. 8 WESTINGHOUSE D. C. GENERATOR
18″ & 30″ X 16″ WESTINGHOUSE A. C. ENGINE DIRECT CONNECTED TO NO. 3 WESTINGHOUSE D. C. GENERATOR
18″ & 30″ X 16″ WESTINGHOUSE A. C. ENGINE DIRECT CONNECTED TO NO. 3 WESTINGHOUSE D. C. GENERATOR
3″ DRAIN
38′ 0″
24′ 5″
4″ DRAIN
TO SEWER
3″ DRAIN
3′
17′ 0″
17′ 6″
17′ 6″
17′ 0″
3′
SWITCHBOARD
3″ DRAIN PIPE
Elec. Engineer

Power House of the Camden, Gloucester and Woodbury Railway Co.

includes a Hamilton-Corliss 300 h. p. engine, furnishing power for a capacity of about 200 American arc lights and an Edison machine used in lighting the fine residence of Mr. W. J. Thompson, more popularly known as the "Duke of Gloster." In addition, the Railway Company has a commodious car barn where it houses it rolling stock of 12 motor cars, with Westinghouse two 30 h. p. equipment each, 12 closed trailers and 18 open trailers. These are supplemented by a sprinkler and a snowplow.

As already stated the road has been built by the Complete Electric Construction Co., of New York, of which Mr. John A. Seely is president, and under the supervision of Mr. J. J. De Kinder, as engineer, of Philadelphia. The investment amounts to about half a million dollars.

THE WINKLER TWIN SERIES ELECTRIC MOTOR.

The most serious trouble which has been experienced with double motor equipments lies in the difficulty of dividing the load equally between the two motors under all conditions of service. While this is partly overcome by the use of series parallel controllers, the latter are not wholly satisfactory, for in passing from series to multiple, there are times when the whole of the load has to be borne by one machine, and after the other motor is cut in again it is some moments before the load is even approximately equalized. The United Columbian Electric Company, of New York, have just brought out their improved twin series Winkler motor for street railway purposes, which obviates this difficulty completely. The company own the motor patents of C. F. Winkler, and the improved motor while generally following the design of the earlier type, embodies several important improvements in the details of construction.

In the Winkler motor, shown in Fig. 1, the desired result is obtained by using only one magnetic circuit, or one field for the two armatures, one of the armatures being geared to each axle. By this arrangement the load is equalized between the two armatures, and, as will be seen, the motor has the economical advantages of the single motor, together with the perfect connection of one armature to each axle of the car.

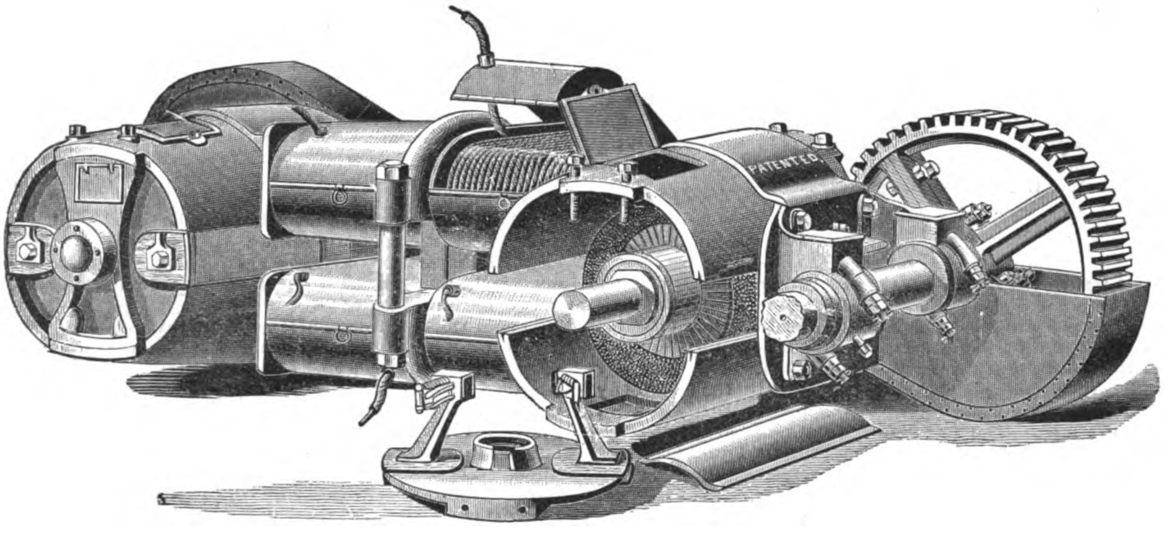


Fig. 1.—New Twin Series Winkler Street Railway Motor.

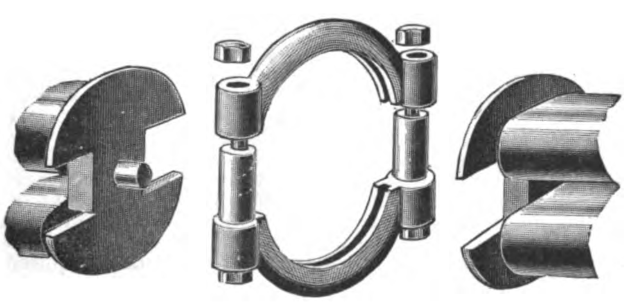


Fig. 2.—Winkler Flexible Motor Joint.

The use of the single magnetic circuit makes practicable the permanent coupling of two armatures in series, for the action of the magnetic lines of force on the two armatures is then identical. This fact compels the two armatures to work in harmony with each other under normal conditions, a result not obtainable when two separate motors with two separate magnetic circuits are operated in series. The efficiency of the equipment is also high, because, as is well known, two motors operated in series with each other are more efficient and can be operated more economically than otherwise, as the counter-electromotive force can be obtained with one-half the number of turns of wire on each armature, which means only about one-half the resistance.

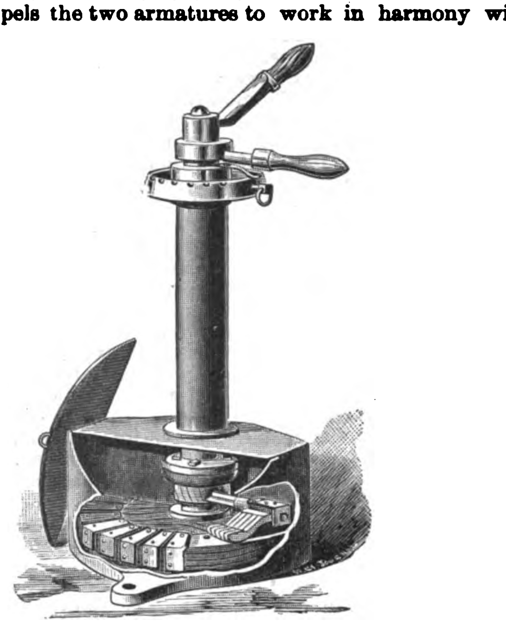


Fig. 3.—The Winkler Car Controller.

In order to avoid the strain on the truck, which would be caused by the rigid coupling of the two axles, an ingenious flexible joint, shown in Fig. 2, has been devised, which, while giving the necessary play between the axles, does not in any way interfere with the magnetic circuit.

The twin motor being a bi-polar machine, can be run with two brushes only to each armature, without increasing the liability for trouble caused by cross connecting the armature coils, as in a multipolar machine.

The controlling device, Fig. 3, is very simple in arrangement and is similar in action to the usual forms of resistance control. An easy start is insured by cutting out consecutively several slow starting coils on the first few points of the switch. After the car is under way the speed can be increased at will by changes in the field circuit. One of the strong points of the controller is that all the mechanism and contacts are on the platform encased in a compact metallic box thoroughly insulated and waterproof.

The controller is made so compact that it does not take up any valuable passenger space, while it insures the perfect protection of all parts from the weather. Another feature is the angle at which the contact fingers are set to the contact plates which prevents arcing between plates when the current is thrown from one point to another. This is effected by engaging each point before leaving the preceding one.

The reversing switch is very simple and is worked by an independent lever. When the motorman removes the switch handle to run the car from the other end, the controller is automatically locked, and cannot be tampered with. The slow starting coils are carefully insulated, fireproof and thoroughly ventilated.

In this motor, while the armatures are usually run in series, either one may be cut out completely, or they may be coupled in multiple when high speeds are desired. In the improved motor the armature is entirely protected from water and dirt, and at the same time the brushes and all parts of the machine are easy of access. All the mechanical features have been worked out with the greatest care. The yokes and supports are made of bronze, and all bearings of phosphor bronze.

The armatures are of the "iron clad" type, the wires being imbedded in the cores in such a way that the winding is carefully protected. Heavy moulded mica insulation is used. The field coils are wound on separate spools, and all parts of the motor are interchangeable and easily accessible. The gears and pinions are cut of cast steel and encased, and all bearings are of ample length. In those for the armature the bearing proper is a loose bushing revolving within the pillow block. It is claimed by practical engineers who have examined them, that by this arrangement the armature bearings will last at least twelve months without more attention than an occasional oiling.

The weight of the motor is all carried on the heavy part at the middle of the axle instead of on the journals, and the rigid connection between the motors prevents all tendency to oscillate. The hammering effect upon the track due to the motion of suspended motors is thus also avoided. The motors are made of both fifty and sixty horse power for a car equipment, and are guaranteed by the manufacturers to work up to their full capacity in continuous service. All the details of the car equipment have been carefully planned, and the very best workmanship and material is used. The factory at Kingston is under the personal supervision of Mr. Winkler, and Mr. H. W. Weller, the new general manager of the company has gained valuable experience during his long connection with electric railway work, with the Sprague, Edison and General Electric Companies.

It is interesting to note that four of these motors are already running so satisfactory at Mobile, Ala., that a fifth has been ordered, and six cars similarly equipped are in operation on the Colonial City Electric Railway at Kingston, N. Y.

AN UNDERGROUND ROAD FOR BOSTON.

By the concurrent action of the Boston Common Council with the action of the Board of Aldermen, the city has finally made a beginning in the solution of its problem of rapid transit. The city has now accepted the act of the last Legislature for a subway under Tremont street, and the Mayor has approved the action of the legislative branch of the city government. The beginning, when finished, will be only a step towards the settlement of the broader question, but it will relieve Tremont street for nearly a mile of its most crowded part, and will also give some improvement to Washington street, the main line of travel and business. Under the act of the Legislature the mayor must appoint a board of three subway commissioners (confirmation to be by the aldermen), who must lay out and construct a subway for street-railway purposes, with two or more parallel tracks, under Tremont street from Pleasant street on the south to Scollay square on the north, with suitable approaches, stations, exits, and entrances. The act forbids the construction of any part of the way under Boston Common. All needed power is given as to means of construction, as regards the right of taking property, and as to the employment of professional assistance. The city is authorized to issue $2,000,000 in fifty-year 4 per cent. bonds. The commissioners shall have the power to compel any line of street railway in the city to make use of the subway on terms prescribed by the railroad commissioners as just and reasonable. The commissioners can also grant to any private corporation the right to put pipes, wires, or conduits through the tunnel upon such compensation as the commissioners shall decide to be proper.

The plan has been to make a light and cheery tunnel, perhaps lined throughout with light brick and lighted with electricity, as agreeable to passengers as the upper air itself.

It is probable that the Subway Commission will not be appointed till the beginning of 1894. Amendments may be asked for the Act at the hands of the Legislature, but the city is now fully committed to the scheme. At best, it will be a purely local relief for a small part of the crowded streets. No other subway is proposed for connection with it, nor will it form a part of any general system. It is merely a dive for a mile underground past a section of Beacon Hill, aiding in no way a comprehensive rapid transit plan.

NEW TROLLEY ROADS.

The Boston News Bureau says: "The American Railroad Improvement Company of Boston, has recently closed a number of large contracts for the construction of trolley roads as follows: A line 14 miles long connecting Sterling, Ill., with the city of Rock Falls, Ill., at a cost of $160,000; a line 28 miles in length running from Red Bank, N. J., to Long Branch, via the Shrewsbury river at a cost of $400,000; a line from Westchester, Pa., to Philadelphia, 38 miles, with stations at intervals of every half mile, standard steam gauge. Cars will be equipped with 250 h. p. motors, and trail cars will be used as far as Philadelphia city limits. This line when completed will be a competitor to the Pennsylvania road, as it is many miles shorter between Westchester and Philadelphia, and considerably better time is expected to be made by the trolley system than by steam. It will cost to construct $1,200,000. A representative of the company is now in Parkersburg, W. Va., closing a contract for the construction of a trolley line at Parkersburg to cost $200,000. This company is also constructing the trolley line between Randolph, Holbrook and Quincy, Mass., which has been completed between Holbrook and South Braintree. Work will be started on all the above lines early in the spring, as soon as the frost leaves the ground. The company has also bid for a number of other roads to be constructed next year, but contracts have not as yet been closed.

MISCELLANEOUS.

THE POOLE & WHITE ELECTRIC TRAIN LIGHTING SYSTEM.

This system, operated in England, embraces a dynamo and accumulators, which for the sake of convenience, are generally placed in the baggage car, although in some cases, such as Pullman and Wagner cars, it has been found more convenient to place a small set of accumulators under each car, so that in the event of such car being detached from the main portion of the train for any length of time, the lamps in that car may be supplied from their own set of cells.

The dynamo being placed in the baggage car, enables the working part of the plant to be easily accessible and examined if required, although it has been found, after working this system on several trains for the past few years, that the automatic arrangements, explained below, are such, that very little attention is ever required.

The dynamo which is sufficiently large to both run the lamps and charge the accumulators, is driven from one axle of the baggage car by means of a belt which passes round an idle pulley and can easily be adjusted to meet the requirements of the belt, should it become too slack.

From the dynamo shaft is driven by means of a small belt, the governor which is fixed either independently or on the frame work above the dynamo. Upon the train reaching a prearranged speed of about 6 miles an hour, a contact upon the governor joins up a circuit of an electromagnet, which in turn connects the main circuit from the dynamo to the accumulators. The accumulators are therefore "charging" until the train speed is reduced to that speed at which it was traveling when the accumulators were put in circuit automatically. At this point, the contact made by the governor altering its position on account of the speed, breaks the circuit round the electromagnet, and allows a spring to switch off the dynamo from the cells.

The electromotive force of the dynamo naturally rises, as the speed of the train increases, and at the same time the position of the dynamo brushes on the commutator is varied by means of the brush cradle being connected with the governor above mentioned, by means of a chain. This prevents sparking and consequently undue heating. The cradle referred to, changes over its position to the opposite side of the commutator upon the train reversing its direction.

To obviate any fluctuation in the lamps, which would naturally occur, when the circuit is broken between the dynamo and accumulators without a proper regulator, on account of the E. M. F. of the dynamo being greater than that of the accumulators, a variable resistance is placed in the lamp circuit from the dynamo and is automatically regulated according to the output of the machine.

It will thus be seen that the working of the whole plant is entirely automatic. The superiority of the incandescent electric lamp over gas or oil lamps is universally acknowledged, especially in traveling, where the best reading light is naturally required by passengers.

The advantages are also easily seen in the saving of labor over gas, the reflectors of which continually require cleaning, and the carriages fitted with the same have to be taken to charging stations causing delay and consequently extra stock, besides the danger which gas presents in case of accidents; and over oil lamps, which require a special staff kept at all the principal stations to change the lamps, clean and trim them. The proportionate weight, for the same amount of light generated, is also in favor of this plant over gas, and therefore makes a material difference in the gross weight of the train.

At the present time twenty-three trains are lighted by this system on the London, Brighton and South Coast Railway. Four of these trains are expresses and nineteen are used for suburban traffic. An order has also been given to increase this number.

It may also be of interest to quote part of a report on the trains equipped on the Poole & White system on one of the English railways:

"The further experience we have had with our electrically lighted trains shows that they are more serviceable to us than gas lighted trains, principally because we save the extra haulage necessary to run the latter to the charging stations. The former are always ready to go anywhere and there is no need to inquire and calculate if the gas reserve is sufficient for the journey, etc.

"It is estimated that the electrically lighted trains render about 15 per cent. more service than gas trains which, taking the cost of building a train of 10 coaches at only £3,000 means a saving of something like £45,000 in the construction of 100 trains.

"The cost of the maintenance and renewals of the electric light in the 30 trains we had running at the end of June last was £1,462 7s. 3d. for the 12 months, say, £48 14s. 10d. per train; but as two or three of the trains were not brought into work until during the second half of the period the average cost per train would come out somewhat higher. The cost appears to depend very much on the number of trains; when we had only a few, the price was about double what it is now. The more trains we have, the lower the average cost for maintenance, the saving being in labor.

"We are now about to fit up 10 more trains, making 40 trains in all, and then we anticipate the cost for maintenance will be less than at present as the incandescent lamp patent expires this year and the accumulator patent runs out next year, I believe."

FIRST COST, PER TRAIN OF TEN COACHES.

1. *Gas.*—In all, including traveling cylinders, buildings, engines, etc., about £650 to £700 per train.

2. *Oil.*—About £120 per train. This does not include cost of buildings, etc., for cleaning and repairing lamps.

3. *Electric Light.*—£400. This price is inclusive of undergear, and, when once equipped, the train is independent and carries its own lighting plant with it and can be sent anywhere at any time.

WEIGHT.

1. *Gas*, 3 tons, 7 cwt. 2. *Oil*, 7 cwt. 3. *Electric Light*, 2 tons, 15 cwt.

MAINTENANCE.

1. *Gas.*—The cost of gas cannot be definitely obtained per train mile, but costs ½d. per hour per compartment = £120 per train of ten coaches per annum. This is for a readable light; but the cost depends almost entirely upon the light supplied, Two burners would give a more satisfactory light but at double the cost.

2. *Oil.*—Varies from £70 to £130 according to the quality of oil and amount of labor used.

3. *Electric Light.*—The actual cost for the last year's maintenance of 30 trains on London, Brighton and South Coast Railway was £48 14s. 10d.

THOUGHTS ON COSMICAL ELECTRICITY.[1]

BY PROF. ELIHU THOMSON.

PROF. THOMSON prefaced his remarks by stating that it was not his intention to give an illustrated popular lecture, but rather to present to the Electrical Section of the Institute a number of thoughts which had come to him, and which must be regarded as in the nature of speculations or guesses. He had attempted to apply known principles to conditions of the heavenly bodies, and he thought there was much to learn in this field.

Beginning with the consideration that as we rise from the earth's surface to different altidudes there appears to be a gradual increase of potential with respect to the ground, such that at a thousand feet, as at the top of the Eiffel tower, there may be 10,000 volts difference between the air at the top and the surface, he assumed that this difference might increase as we reach high altitudes, and that at 20 or 30 miles the potential difference might amount to a million volts more or less. This would seem to indicate the possession of a positive charge by the higher layers of the atmosphere. He stated, however, that it had not yet been proved that a pure gas could carry a charge of electricity, and instanced the case of a drop of water suspended in the air and charged to a certain potential,; if the air were dry and the drop evaporated, the potential would rise gradually until, when it was entirely evaporated, the potential would be infinite. This consideration would be based on the fact, if it be a fact, that liquids in evaporating do not part with their electricity. The increased potential of the drop, however, might have other effects, such as the repulsion of its particles and its division into an extremely comminuted state. Still, on evaporation to pure vapor the electricity must go somewhere.

After stating the nature of the electrical charge as dependent upon capacity and potential, he showed that whenever the capacity is diminished, the potential with a given amount of electricity rises, and vice versa; but went on to state that attraction and repulsion, and other phenomena could be explained by the general tendency of all bodies to increased capacity. He adduced considerations going to show that there was a relative repulsion between liquid charges of electricity besides the attraction between opposite charges, and that therefore, the lines of electrostatic stress would agree with those of magnetism in their tendency to shorten and also to spread laterally.

He then took up the question as to whether a perfect vacuum is, or is not, a conductor of electricity and brought forward the results of recent investigations as showing that an excellent vacuum is not a conductor, but on the other hand is the most perfect insulator. Taking this in connection with the fact that dense air is a good insulator, that rarefied gas is a fair conductr, and that the solid body of the earth is a conductor, he compared the earth to a huge condenser possessing a positive charge in the outer layers, while the earth itself might be less positive or negative. Using the results of Prof. Rowland's works on the movement of a charged body giving rise to magnetism, and the principle of an air condenser, he put forward the idea that the earth, being a huge rotating condenser with a positive charge in the upper layers of the atmosphere and negative charge at the ground, it would necessarily follow that the magnetism could be developed in the region between this upper layer and the earth by the rotation of these charges.

He then traced the actual direction of the magnetism which would be produced, finding that the direction was the proper one to accord with facts and that the compass needle indicates the direction. He reverted to the idea which had come to him that possibly thunder storms were in a measure due to flaws in the dense air as a dielectric and explained in detail, somewhat, his thoughts on this subject. He drew attention to the consequences which would follow the possession by a mass of nebulous gas of a charge of electricity; this, if insulated in space, would, as its volumes diminished by the radiation of heat and condensation, gradually increase in potential, however small the charge originally possessed. The sun might, therefore, be a charged body having a relatively high potential, which potential would undergo elevation on further condensation. He put forward, as a thought on this subject, a possible explanation of the solar periods as due to electrical states, the sun reaching a certain potential and then by the repulsion of small electrified particles losing that potential by the passing of the coronal stream, and not only a part of the charge which it possessed, but also a considerable amount of the charged material which might be encountered by the earth in its movement around the sun, and so gave rise to an auroral display. He showed that the action would necessarily be the periodic one. He showed the tendency of electrified bodies to lose their charge, especially in the presence of rays of light and the higher rays of the spectrum, and thought that this action might possibly have some relation to the possession of and disposition of charges by the heavenly bodies.

He concluded the lecture by stating that it was possible, in his opinion, that temporary stars, that is, stars becoming visible and then fading away, might therefore be explained on an electrical hypothesis, viz., that charged bodies possessing a difference of electrical potential when they approach near enough might exchange electricity between themselves on the grandest scale, giving rise to a uniformity of charge on their leaving each other; that this would naturally be done in a vast display which would only last for a moment of time. He stated in conclusion that these were only thoughts after all, but such as he believed would be of interest to the members of the Section.

SOCIETY AND CLUB NOTES.

FRANKLYN INSTITUTE MEDALS.

THE FRANKLIN INSTITUTE, of Philadelphia, calls attention to its special rewards for meritorious discoveries and inventions in the shape of the Elliott Cresson gold medal, the John Scott legacy premium and bronze medal, and the Edward Longstreth silver medal of merit. Full information as to the manner in which these medals are awarded can be obtained from Dr. W. H. Wahl, the secretary of the institute.

AT the annual meeting of the Institution of Electrical Engineers, Mr. Alexander Siemens was elected president.

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[1] Abstract of a lecture delivered before the Electrical Section of the Franklin Institute, Tuesday, December 12, 1893.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - -	per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies, - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

VOL. XVII. NEW YORK, JANUARY 3, 1894. No. 296.

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HIGH INSURANCE RATES.

FROM time to time we have quoted the opinions of insurance experts as to the dangers resulting to property from the use of electricity, but we have seldom struck anything more terse and vigorous than the utterances of Mr. Francis W. Whiting, manager of the New York Tariff Association, while in Boston a few days ago. That gentleman says of electricity:

> "Before its almost universal use, insurance companies made money, leaving out the years of the Chicago and Boston fires. The insurance business prior to the extensive use of electricity had been conducted at a profit. You will notice that the people who burn are not the bad element. They are people who don't want to burn, so that the moral hazard feature is not a very important factor in the fire loss. We are losing by fire the very choicest risks, risks we made money upon at one time. What burns them? Investigate, and you will find in almost every important case it is the concealed wire. One thing to be observed in support of this is that the fires which start from 'unknown' causes are becoming remarkably common, and not in property which underwriters would class as bad risks. The evidence of the distrust placed upon concealed electric wires is demonstrated by the charge made in the universal mercantile schedule against the use of electric lighting."

We need not wonder that after such a deliverance, Mr. Whiting should declare that he knew of no remedy but to abolish the use of electricity. It is a great pity he cannot be accommodated. It would be much easier to abolish Canute Partington Whiting.

But the matter is one to be taken altogether seriously, and since our insurance friends insist that the increase in rates is wholly due to the growing use of electricity, we will state one simple case which shows the absurdity and hollowness of their contention. One of the editors of THE ELECTRICAL ENGINEER lives in a large apartment house uptown in New York. It is wholly residential property, has no stores under it or near it, and faces two sides on open park. It has never had a single electric light in it, and the nearest street electric light circuit is a full block away. Last year, the insurance on furniture, etc., secured by this member of our staff was at the rate of 15 cents per $100, through a broker. This year, the rate demanded and paid is 70 cents per $100, although a slight saving of 15 per cent. discount has been effected by dealing direct with the insuring company. Such a case as this, of which all the documentary evidence is in our possession, shows that while it may have been necessary for the companies to get better rates, *electricity has nothing to do with it.* We suggest to Mr. Whiting that if he values his reputation as a shrewd and conservative man, it is time he drew in with an apology the absurd remarks he made as quoted above, and gave electricians the benefit of his advice and assistance in rendering absolutely safe the best light and power now known to man.

ALTERNATING MOTORS FROM SINGLE PHASE CIRCUITS.

THE adoption of the two-phase, or, more generally, multiphase, system of distribution for power purposes at Niagara, after prolonged and careful investigation, carries with it a strong endorsement of the present superiority of that method, and will still further stimulate activity in this field. But, judging from some of the remarks contained in Prof. Forbes' paper, not a few prominent electrical engineers are busy at work on the production of a single-phase motor designed to operate on the ordinary two-wire circuits, and, indeed, a number of such are already in operation abroad on quite heavy work. For those who are working at this problem, the work of Mr. Tesla in this field, illustrated in the present issue, will prove of interest. This far-seeing inventor early recognized the demand which would arise for a motor adapted to be run on two wires, and hence turned his attention to the methods for creating a local difference of phase by the introduction of inductive, as well as non-inductive, devices. The wonderful flexibility of the alternating current is nowhere better shown than in the variety of methods here employed for accomplishing the same common object.

THE BERLINER PATENT.

The suit of the Government for the annulment of the Berliner telephone patent is again receiving attention in the electrical press and in the daily newspapers. Reports are alleged that the case against the Bell Company has made but little progress, and apprehensions are expressed that this suit may be protracted over a period of many years, like the old suit against the Bell patent. We have good reason to say that both the reports and apprehensions are unfounded. The taking of testimony in the case has gone forward with reasonable diligence and there seems to be no reason to doubt that the case will be ready for argument in May next. We are advised that the defendant, the Bell Telephone Company, is even pressing the other side for dispatch in furthering the completion of the proofs. The Bell Company may well be desirous of bringing the suit to an issue as early as possible. In the suit to annul the Bell patent its interests were all for delay, the patent having been adjudicated and infringers enjoined. In the Berliner case the interests of the Bell Company are obviously for an early decision. The Berliner patent has not only never been adjudicated, but the circumstances of its issue after fourteen years delay in the Patent Office afford an additional presumption against the likelihood of injunctions under it pending the final determination of the Government suit.

TAXATION BY FREE PASSES.

Trolley roads that are feeling the pressure of the times might do worse than imitate the example set by the Consolidated Traction Company of Newark and the South Orange and Newark Railroad Company, which are to withdraw all free passes in Newark on and after January 1, so that only policemen and firemen in uniform will be able to take free rides. It appears that these companies have out at least 1,000 passes. If used but once a day, these passes represent a loss to the companies of $18,250 per annum in fares. The probability is that such use as that would be rather the minimum than the maximum; but even if the companies netted only half the amount it would be a substantial addition to their incomes. They could appropriate it in extra dividends, or if philanthropic, raise salaries and give the public a few extra facilities. As a matter of fact, the free pass granted so indiscriminately as to show a list of 1,000 "deadhead" street car travelers on two trolley roads in a city like Newark, would indicate that a similarly judicious reform could be instituted elsewhere.

THE QUESTION OF CAR BRAKES.

The recent animated discussion in our pages on the desirability of some better method of car control has received a noteworthy contribution in an accident that occurred at Troy, N. Y., on December 28. It appears that a car on the Troy City line got away from the motorman. Brakes were applied, but although the wheels ceased their revolution they skidded and the car went on with increasing momentum. The sand box was freely used and other sand thrown on the track, but to no avail. There was nothing left for the passengers but to jump out. One lady in doing so broke her leg. The motorman stuck bravely to his post on the car, which, after knocking over a fire alarm pole and breaking off at its base a telephone pole, plunged headlong against a building which it shook violently and with a great noise. The car was smashed to pieces, and the motorman was so badly injured that he may not recover. Had not the car butted the building at the foot of the hill, it would have committed suicide in the Hudson just beyond.

It would seem that this was a casualty that might have been avoided. It should have been possible to reverse the motor instantly, and run up hill. This was not done, probably because it could not be done with the brakes jammed. As a rule, the brakes on street cars are none too good; but even when they are at their best, such accidents happen. That better, or additional, means of control are needed is obvious.

Electrical Canal Propulsion.

We have received from the New York Produce Exchange a copy of the report made recently by its Committee on Canals, of which Mr. G. W. Balch is chairman. It is an able document and proves once more how great is the value of the Erie Canal to the State of New York. A ready explanation of the desire to improve the Erie Canal facilities is furnished by the statement that in handling a cargo of 90,000 bushels of wheat, a Lake vessel from Duluth to Buffalo, would earn $2,025, while the canal boats from Buffalo to New York—half the mileage—would receive $4,275. The committee approves the deepening of the canal, and speaks most favorably of efforts to apply electrical propulsion. Steam, it says, has been far more economical than the mule, but "it is doubtful if its use can be economized to an extent sufficient to fully meet the requirements." The committee wisely urges the canal boat owners to lend their support to all methods aiming at improvement, and plainly informs them that their prosperity can only come with improved conditions of propulsion.

The Work of Joseph Henry.

Two years ago we had the pleasure of laying before our readers a very interesting series of articles by Miss Mary Henry on the work of her father, Joseph Henry. Since that time, the name of our great countryman has been adopted for one of the new units, thanks, in some degree, to this filial work. Encouraged by the reception of her first series, Miss Henry begins in our present issue a second series devoted especially to her father's work on the electro-magnet and the electro-magnetic telegraph. Prof. John Trowbridge, of Harvard, has kindly written a brief introduction.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—III.

BY PROF. GEORGE FORBES.

PARALLEL WORKING.

ENGINEERS in America have had no experience in actual commercial conditions of parallel working with alternators. This is partly because the machines which have been made in that country do not work so well as some others in parallel. In the case of the transmission from Niagara Falls my opinion is that parallel working will give the best results. If this arrangement were not adopted it is obvious that when the dynamos are loaded up as much as possible they could never be all fully loaded. It is also quite obvious that if our conductors are to be carried through subways the space required becomes quite excessive unless we adopt parallel working. The complete success of parallel working between Tivoli and Rome left no doubt as to the feasibility, besides the desirability, of adopting parallel working. The reduction in frequency which we have made assists very considerably in this result, and it says much for the American manufacturer who has received the contract that, although parallel working with multiphase machines has not been adopted in the past, he is ready to guarantee the performance in this respect of the machines which are to be built for us.

The rules which govern the construction of machines which shall work well in parallel are not very clearly understood. The only fact which has been perfectly established in practice is that the lower the frequency, the more efficient and sure is the parallel working. It certainly depends to some extent upon the amount of self-induction and the amount of mechanical momentum in the machines. It is also certain that if the self-induction of the machines is too high they will not work well in parallel. Of all machines which have been constructed, those which work the best in parallel appear to be those of Ganz & Co., Mordey, and Elwell Parker, but there are many others which do extremely well. It is, at present, not possible to state exactly the conditions which are necessary, but I may say that, generally, a machine with a stiff magnetic field works better than one where the iron is far below magnetic saturation. In judging whether a machine of a particular type will or will not work in parallel, I think one must be generally guided largely by one's own personal experience in the matter, combined with a knowledge of the effects of self-induction, mechanical momentum, and magnetic saturation as deduced from theoretical considerations. I do not think that anyone who knows anything of the working of the Tivoli-Rome plant would for a moment hesitate in saying that on a large and important station like that of Niagara Falls parallel working is essential; and this is the opinion of Prof. Mengarini, who has so ably directed the works at Rome.

MOTORS.

Under this section it may be as well to discuss some of the different purposes for which the electric current will be required. With regard to arc and incandescent lighting, if the frequency be high enough, the current can be used directly for this purpose; although most people would prefer that, in the case of arc lighting, the current should be commutated or converted in some manner, so as to give a continuous current. That this is unnecessary, however, is amply proved by the perfect success of the arc lighting by alternating currents in Rome and many other large cities, especially those which have been established by Messrs. Ganz & Co. At the present time, one of the largest applications of electricity in the United States is for street railways, which require a continuous current. Another similar purpose which we shall have to consider is the application to canal boats, since it is intended to work the Erie Canal by electricity. This canal starts from the Niagara River, and reaches the Hudson River at Albany, 350 miles distant. For these purposes some sort of commutator or motor transformer will be desirable. Some of the first work which will be done is the supply of much direct current at 150 volts for the production of aluminum. This also requires the continuous current, and similar means must be used for obtaining it. Among the large class of mills which will be established at Niagara Falls, one of the most important kind is wood-pulp mills, one of which is already working on our land, and will be the first to receive water-power from our canal. This type of mill uses many thousands of horse-power, and is worked continuously day and night. In this feature it resembles, probably, a large number of the mills which will take advantage of the cheap power at Niagara Falls. Such mills are working continuously day and night, and do not require to be ever stopped or reversed. This is an important class of work in our case, because current can be supplied to such mills by means of synchronizing alternators whose efficiency is extremely high, and this may, perhaps, be done in some cases without transformers. We require also to consider the case of small motors for use in shops, and for elevators, cranes, and a large number of other purposes. In this type of motor frequent stoppings and reversals are necessary. Hitherto direct-current motors have generally been employed for this latter purpose, but the rotating-phase induction motors are distinctly suitable, and when these have been fully developed they will probably be largely used for this purpose. The commutated current is a thing which is sure to be in common use before long, and although our arrangements at Niagara Falls are perfectly complete without a machine for this purpose, still its employment has been considered by us, and the probability of its future use has influenced our judgment in some points. There are so many purposes for which the direct current is most convenient, that people would generally accept it for transmission if it were capable of being economically transformed up and down to different pressures. The direct-current dynamo is really an alternating dynamo with a commutator placed upon it. If the commutator, instead of being placed there, be placed in the neighborhood of the motor, we obtain most of the advantages both of the continuous and of the alternating current. This is one of the advantages of having two phases generated by the dynamo, because it is much easier to rectify a two-phase current than a single-phase current, In addition to the motors above specified, there are a large number of single-phase motors which start with a powerful torque which have been invented by different electricians, but which are not yet put upon the market. There are also machines with commutators like a direct-current dynamo with laminated field. These all become very efficient and useful when the frequency of alternations is sufficiently diminished.

LINE CONSTRUCTION.

A great deal of attention has been given to the different methods by which current can be conveyed to the points of consumption, whether on our own property or at Buffalo, or even further. Naturally the pole line was first dealt with, in which the poles might be constructed of either wood or iron. This is the cheapest type of construction, and has some advantages, but we must consider the climatic conditions in the neighborhood of Niagara Falls. We are subject there to severe thunderstorms, and troubles from lightning have already been serious in several parts of the United States in connection with electrical machinery. Snow and frost are very severe, and sleet forming upon the wires and insulators may cause a great amount of trouble. There are also at times very violent gales sweeping from over Lake Erie. All these difficulties can be counteracted to some extent, but it is nearly certain that with overhead construction occasions would arise when the continuity of operations would be interrupted, and this would be a very serious matter. The next system to be considered in order of cost would be underground cables, but I am strongly opposed to the adoption of these for any considerable length. It is true we are able to deal with their capacity so as to reduce its injurious effects, but surely the best plan of all is to abolish the capacity itself as far as possible. The most satisfactory method of proceeding is to build a subway of sufficient size to enable a person to walk along it and to carry bare copper conductors in it, but this a matter of considerable expense. I am glad, however, to be able to inform you that the officers of the company resolved last summer that a subway such as I have described should be constructed from the power-house up to the Pittsburgh Reduction Company's works, where aluminum is to be produced, a distance of 2,500ft. In accordance with their instructions I prepared plans, which give space enough to carry the conductors at 20,000 volts for all the power that will be developed by the present tunnel, parallel working being adopted. The subway is built of concrete having a minimum thickness of 10in. The height inside is 5ft. 6in. Wooden beams are embedded in the concrete on both sides every 30ft. When the concrete is set these beams are removed, and iron castings for supporting the brackets that hold the insulators are put in their place, and these are then grouted in. Iron brackets are bolted to these castings, and the oil insulators placed upon them. We shall probably adopt copper strip conductors. The bottom of the subway is always on an incline, and is of curved shape to drain off any water of condensation, but it is also proposed to force air through the subway so as to keep it dry. The 2,500ft. now being completed is all drained at the power-house end by a boring into a water-bearing stratum. At the bottom of the subway the concrete is formed in two steps, the lower one of which supports sleepers for a very light tramway upon which a truck can run to carry supplies, and also to carry the inspector. At first this can be moved by a hand lever, but arrangements are made for eventually driving it by electricity, the conductor being carried on the floor, between the stringers (placed on the ties or sleepers), which form a platform running along the length of the subway. On the stringers outside the rails is placed a screen separating, mechanically and electrically, the part of the subway where the conductors are from the part where the inspectors walk. This screen is formed in 10ft. lengths of wood supporting expanded metal, covered over with plaster up to a height of within one foot of the top, the upper part being left open in the form of a network, through which the inspector can look at the conductors and their supports. These screens are held by iron supports fixed by expanding bolts into the concrete, and can easily be removed. The top of the arch is 3ft. below the surface of the ground, so that it will not be affected by frost. According to the last report, it appears that on October 21st 1,590ft. of this subway had been completed; the total length being put down at present is 2,500ft. Each of the iron castings has a wire attached to it which passes through the concrete, and is soldered to a copper wire running outside the subway along its whole length, and connected to a plate sunk in the water at any suitable points. At every 400ft. cross streets will be made, and at these points there is a manhole. Also at these points, on each side of the subway, four drain pipes, 3in. in diameter, are let in, closed at their outer ends. When the subway is to be tapped for use on the side streets, or for intermediate points, wires can be laid through these pipes. Between Niagara Falls and Buffalo there is very little rock, but the part where the subway has now passed through has been chiefly in rock. This involved blasting out a channel larger than was required. In this case the part of the trench outside of the subway has been built up of stone. In the construction of this subway American Portland cement has been used, and a very suitable sand from the neighborhood, which contains its own gravel. The whole of this work has been done by Mr. Humbert, and up to the date of my last inspection every part was thoroughly and satisfactorily done. This work is of great importance as conveying to the minds of those who intend to use our power some idea of the desire to ensure continuous working.

With regard to the electric pressure that is to be used for distant transmission, this will undoubtedly advance with experience. Some manufacturers in Europe who tendered for the work proposed to adopt 25,000 volts; but we have considered that at present 20,000 volts is not likely to be exceeded by us, and we may work at a lower pressure at the commencement. When it is remembered that the Deptford machines have one terminal connected with the earth, and are working satisfactorily at 10,000 volts, and when it is noticed that, in consequence, our work would be under exactly the same conditions as regards insulation when working at 20,000 volts, it is easy to see that we are not risking anything experimental in our first work.

With regard to the size of conductors, I worked out the economical size at different current densities for the whole distance. In doing this I took the following data:—I took the cost of copper at 12½ cents per lb., and the annual charge on this cost at 5 per cent. I then computed the power loss in the line, and the amount of power which was left available for delivery. I took the value of this power at the distant end of the line as being $15 per horsepower. This is something more than what it costs us to produce it, but when the power available from our tunnel is nearly all consumed this quantity will have to be increased. It must also be remembered that I have not allowed for the increased size of the conductors required by the retardation of phase, which is an unknown quantity. Still, it will be seen that from these considerations we may be able to work economically at a slightly higher current density than is obtained from this investigation. From this work it appears that the most economical density to work at is 350 amperes per square inch. If this density is used the fall in volts between Niagara Falls and the northern boundary of Buffalo is only 3½ per cent.—a matter which makes regulation extremely easy.

With regard to the efficiency of the system, it is remarkable how high the efficiency of the dynamos comes out when we are dealing with the large units of 5,000 h. p. There can be but little doubt that the efficiency, electrical and mechanical, of our dynamos may reach at least 98 per cent. Taking off 3½ per cent. for losses on the line, we would have 94½ per cent. delivered electrically at Buffalo if no transformers were required to raise the electric pressure to the full 20,000 volts. In cases at Buffalo, where the power consumed is very large, the motor can be constructed on the same principles as the dynamo; and if in this case it be ever possible to work at the full pressure without a transformer, it is obvious that the total efficiency of the system—that is, the power delivered by the motor to the shaft of the machinery, divided by the power delivered by the shaft of the turbines to the dynamo—will be certainly over 90 per cent. As a matter of fact, if we were to use a higher density of current, and were to use step-up transformers at Niagara Falls and step-down transformers at the northern boundary of Buffalo, and other step-down transformers in the town of Buffalo itself, and were to use motors of small power, and consequently of less efficiency, in this case the total efficiency of the plant might be reduced to 80 per cent., or even lower.

I have given these figures not as indicating precisely the lines on which we have determined to work at Buffalo, but because the present paper is intended to embrace the subject of the general distribution of power, and I thought it desirable to lay before you certain facts in this connection in a definite form.

DESCRIPTION OF MACHINERY TO BE USED.

Under this heading I shall deal chiefly with the type of dynamo which has been finally decided upon. It will suffice to say of the turbines that they are each of 5,000 h. p., that they revolve at 250 revolutions per minute, and were designed by Messrs. Faesch and Piccard, of Geneva. All the principal parts of this machinery were constructed by the I. P. Morris Company, of Philadelphia, but the governors of the turbines are of Swiss manufacture, and part of the steel fittings were constructed in France.

With regard to the dynamo, the Cataract Construction Company at first invited many different manufacturers in Europe and America to submit plans. The number of these that were submitted altogether amounts to 24, some of the manufacturers having taken a great deal of trouble to submit a series of designs, in order to be able to meet different requirements. Many of these designs were extremely good; but it was determined, after estimating the increased cost of using the European designs, owing to the high tariff in America, and owing to transport, to have the machines manufactured in America. Among the designs from American manufacturers there were none which fulfilled all the requirements of the case, and eventually the Cataract Construction Company decided to get out their own designs, and to submit them to the American manufacturers for tender. I had been for some time previously engaged in working out a design which I am confident none of the manufacturers who had sent in designs could say was in any way borrowed from their ideas. We had received suggestions of an external armature with internal revolving fields, and also of external fixed fields and internal revolving armature. We naturally had a preference for a dynamo with a fixed armature, because the coils can be more securely wound, and are not subjected to the mechanical stresses induced by centrifugal force. But all the designs with revolving fields which had been submitted to us contained a weak feature: the field coils were held in by pole faces secured by bolts or keys to the poles, and this seemed an element of weakness when we considered the enormous centrifugal forces to which the machinery would be subjected. At the same time the turbine makers had insisted upon having a certain momentum, or fly-wheel effect, which was not given by the revolving parts of any of the dynamos submitted to us, and it was found that if anyone of these had been accepted it would have been necessary to add to the design a fly-wheel of large dimensions. Centrifugal force was one of the most important matters to be considered, because at 250 revolutions per minute this force assumes considerable magnitude in the large masses with which we had to deal. Moreover, in all the designs which had been submitted, the magnetic pull between the poles and the iron of the armature assisted the centrifugal force. The principal feature of the design upon which I was working, consisted in having the armature fixed, and inside the machines, with the fields revolving outside; the fields being formed of a ring of iron with the poles projecting radially inwards. One advantage is that we are able to get the full fly-wheel effect that was required by the turbine makers. This requirement was that in the revolving part the sum of the weight in pounds of each part, multiplied by the square of its velocity in feet per second, should equal 1,100,000,000. The design also gives an extremely good mechanical construction for the revolving parts. The iron ring which forms the yoke of the field serves as a support to hold in the pole-pieces and the exciting coils, and no part is held in against centrifugal force by bolts or keys. Moreover, the magnetic pull between the fields and the armature acts in opposition to, and does not assist, the centrifugal force. The armature is fixed, and a large space is available inside it for the workmen to attend to the bearings, and to reach any part of the armature. It is obviously possible to insulate the armature coils for any electric pressure. With a large machine of this kind, the space occupied by insulation has not the same importance in reducing the output of the machine as is the case with machines constructed in the past. In fact, the armature coils can be wound with the same insulating properties as a transformer, and hence the necessity for using a step-up transformer can be avoided.

Starting with this general principle, I first got out designs of a machine at 33 periods per second, in order that I might compare the general appearance of such a machine with those of other types. The next point was to design a machine of as low a frequency as was possible under the limiting conditions as to weight. The revolving parts of the turbine and dynamo, and the shaft connecting them, are supported by a hydraulic piston, and it was the desire of the Cataract Construction Company not to use a thrust bearing of any kind to support the weight, although there is a thrust bearing at the top of the shaft, which simply acts to retain the apparatus in a fixed position in a vertical direction. Owing to this decision, it was necessary to limit the weight of the revolving parts of the dynamo to 80,000 lbs. In getting out the design for the machine it was desirable to select such a form of winding as past experience led one to believe would be most efficient for parallel working, and I judge from past experience that this is best attained by having the number of coils per pole very small. The 33-period machine has only been sketched out with a view of getting at the general dimensions of the machine. It is not suitable for our special purpose, because it is essential that, without taking the dynamo altogether to pieces, we should be able to lift up through the centre of the dynamo any parts of the turbine shaft which may require repair.

It will be seen that from the necessities of the case at Niagara Falls, the dynamo which was required differed in some respects from what would be necessary in may other cases, but it is equally obvious that in any case of so large a transmission of power the conditions must be thoroughly considered beforehand, and the dynamo specially designed for the purpose. At the meeting of the Board of Directors of the Company, in May, 1893, I was instructed, with Dr. Sellers, to get out plans for an alternator of the type which I have described.

I am not able to lay before you now plans of the machine as it has been finally adjusted by conference between ourselves and the manufacturers. In the plan which we prepared, the frequency was 16⅔ periods per second, there being eight poles. The armature coils are so wound that they might be connected to give either 2,500, 5,000, 10,000 or 20,000 volts, and the coils were limited in numbers so as to give the best assurance of good parallel working. For various reasons we decided eventually to raise the frequency to 25, and to lower the volts to 2,000, without the means of connecting the coils to give a higher pressure; and instead of winding the armature on the conductors in a limited number of coils, to adopt the methods more commonly used in some of the large types of generators. But since in any future work which is done, the dynamo will be required to be modified for the special purpose, a description of the machine is sufficiently representative of the type of machine for our purpose.

LETTERS TO THE EDITOR.

THE SIEMENS & HALSKE CO. NOT ENJOINED.

In the ENGINEER or Dec. 20 there appears a note to the effect that "the General Electric Co. have secured an injunction against E. G. Bernard, together with the Siemens & Halske Co. and Major Isaac Arnold, commandant at the Watervliet Arsenal, restraining the contractors from proceeding with the erection of the new electric plant, claiming it to be an infringement upon the Edison three-wire system."

I beg to inform you on behalf of the Siemens & Halske Co. that the above statement is an error. The facts of the case are, that the General Electric Co. obtained a temporary injunction against E. G. Bernard, the contractor, for an alleged infringement of the "Feeder and Main Patent." The Siemens & Halske Co. are in no wise concerned, are not a party to the suit, and have nothing whatever to do with the construction of the plant. So far as the said company are concerned, all that they have done is to have sold three Siemens generators to Mr. Bernard. It is assumed that the Siemens & Halske Co. have a right to sell the machines which since 1867 have borne the name of their inventor.

GEO. H. BENJAMIN, *Atty.*

NEW YORK, Dec. 21, 1893.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 19, 1893.

Alarms and Signals :—

Electric Railway Signal, J. Ortega y Espinosa, Mexico, 511,131. Filed Oct. 26, 1891.

Electrical block system for steam railways.

Signal for Cable Railways, J. Sachs, New York, 511,168. Filed August 4, 1893.

Employs movable circuit controlling devices in the conduit and mechanical appliances moving with the car and brought into action with the controlling devices.

Electric Signaling Device for Hose, G. L. Barnard, Milwaukee, Wis., 511,188. Filed Aug. 29, 1892.

Dynamos and Motors :—

Brush Holder, J. R. Coffman, Detroit, Mich., 510,892. Filed Dec. 9, 1892.

Relates especially to regulating the pressure of the brush against the commutator.

Electric Locomotive, C. F. Winkler, Troy, N. Y., 510,947. Filed March 11, 1893.

Employs two armatures geared respectively with the two car axles, and a single field magnet acting upon both armatures.

Brush Holder for Dynamo Electric Machines, F. E. Averill, Syracuse, N. Y., 510,952, Filed Feb. 13, 1893.

Consists of a frame loosely mounted on a supporting spindle, an arm fixed to the spindle and a spring connected with the arm regulating the pressure of the brush.

Hand Regulator for Electric Motors, W. D. Packard, Warren, O., 511,157. Filed Dec. 8, 1892.

The invention consists in providing a rheostat with clock work mechanism for controlling the operation of the switch arm, a spring impelled wheel, and an electrically operated stop for limiting the movement of the wheel.

Electric Motor, O. F. Conklin, Dayton, O, 511,196. Filed July 6, 1893.

Employs pole pieces inclosing the ends of the field magnet core and having segmental channels in which the armature is adapted to revolve.

Brush Holder for Electric Motors, J. J. Robinson and F. B. Perkins, Toledo, O., 511,214. Filed Feb 6, 1893.

Has for its object especially to guard against the possibility of contact of the metal with the commutator.

Galvanic and Thermo-Electric Batteries :—

Electrical Connector, F. G. Curtis, New York, N. Y., 510,898. Filed Feb. 13, 1893.

Relates to means for connecting primary batteries to one another.

Method of Adjusting the Joints of Carbon Electrodes, E. B. Cutten, New York, 510,899. Filed March 28, 1893.

The method consists in means for indicating the resistance at the joint and then adjusting the parts until a certain definite resistance is indicated.

Electrode for Voltaic Cells, E. B. Cutten, New York, 510,901. Filed May 1, 1893.

Employs a carbon electrode with a glass support, the former being secured to the latter by the material of the support.

Electrode for Voltaic Cells, E. B. Cutten, New York, 510,902. Filed May 1, 1893.

Similar to No. 510,901.

Primary Electric Battery, E. Poppowitsch, Brooklyn, N. Y., 511,159. Filed Dec. 28, 1892.

Employs a packing of saw dust, sea salt, sal-ammoniac, bichromate of potash, granulated manganese and concentrated sulphuric acid.

Thermo-electric Element, M. Mestern, Turin, Italy, 511,245. Filed Apl. 9, 1889.

Consists of a block of iron in contact with a block of alloy composed of zinc and antimony.

Heating :—

Temperature Regulator for Electric Heaters, A. M. Butz, Oak Park, Ill., 510,889. Filed Dec. 24, 1892.

Lamps and Appurtenances :—

Electric Arc Lamp, A. Hormel and G. S. Junginger, New York, 511,049. Filed March 24, 1893.

Employs a hollow electrode and a spirally grooved carbon rack inserted within it, the former provided with pins projecting into the groove of the latter and serving as guides.

Electric Lamp, A. Zobel, Munich, Germany, 511,229. Filed Feb. 15, 1893.

Employs three leading-in wires and two filaments each connected at one end with a common leading-in wire.

Miscellaneous :—

Apparatus for Electrolytically Producing Soda and Chlorine, E. B. Cutten, New York, N. Y., 510,900. Filed March 30, 1893.

Electric Pump, F. W. Merritt, Duluth, Minn., 510,931. Filed Dec. 2, 1892.

Electric Elevator, F. A. Perret, Brooklyn, N. Y., 510,932. Filed Nov. 12, 1892.

Employs in addition to the armature circuit and the field circuit, a third circuit including an apparatus controlling the rheostat in the armature circuit; this third circuit being a direct shunt to the brushes of the motor.

Label Holder, J. H. Shaffer and E. Horowsky, Allegheny, Pa., 511,167. Filed Dec. 21, 1892.

Rheostat, F. A. Weller, Boston, Mass., 511,259. Filed April 20, 1892.

Relates especially to the arrangement of the rheostat within a small compass, and to the proper ventilation of the coils.

Resistance Box, A. O. Benecke, Newark, N. J., 511,286. Filed Sept. 10, 1892.

The combination in a set of resistance coils or bridge of a series of fixed contact plates, a series of resistances respectively interposed between successive contact plates, and circuit connections and means whereby one or more of the intermediate contact plates may be electrically connected with either of the end plates of said series.

Railways and Appliances :—

Electric Railway Switch and Crossing, W. W. Hendrix, Bowling Green, Ky., 511,017. Filed Aug. 5, 1892.

Electric Railway Trolley, W. W. Hendrix, Bowling Green, Ky., 511,018. Filed Aug. 5, 1892.

Employs a guard for the trolley wheel consisting of two jaws closing above the wire and adapted to be forced apart by each hanger and to spring back into position after the hanger has been passed.

Electric Railway Trolley, W. W. Hendrix, Bowling Green, Ky., 511,019. Filed Oct. 7, 1892.

A rotatable trolley pole revolving upon a circular track on the roof of the car.

Electrically Operated Railway Switch, C. A. Stone, Newton, and E. S. Webster, Boston, Mass., 511,173. Filed Aug. 30, 1892.

Closed Conduit Electric Railway, W. S. Smith, Berkeley, Cal., 511,254. Filed Feb. 29, 1892.

Employs junction boxes between the sections of the conductor with ball and socket joints between the conductor and the walls of the boxes.

Switches and Cut-Outs :—

Electric Regulating Switch, E. A. Barber, Watertown, N. Y., 511,187. Filed June 26, 1893.

Has for its object to automatically transfer the energy not needed for operating motors on the main line to suitable resistance coils for absorbing the surplus energy.

Electric Switch, J. L. Hinds, Syracuse, N. Y., 511,240. Filed Nov, 27, 1891.

A snap switch for incandescent circuits.

Telegraphs :—

System of Telegraphy, J. A. Parker, St. Louis, Mo., and L. L. Summers, Chicago, Ill., 510,929. Filed July 30, 1892.

Relates especially to means for increasing the speed and accuracy of the operation of stenographic transmitters.

Telegraphic Relay, E. Weston, Newark, N. J., 511,005. Filed June 4, 1891.

Employs a fixed body of magnetic material disposed in the field of force of the magnet, and a coil of conducting material surrounding the fixed body and supported by pivoted shafts.

Telautograph, R. M. Hunter, Philadelphia, Pa., 511,081. Filed May 26, 1893.

Telegraphic Transmitter, H. F. Stine, Dec'd., Red Bud, Ill., 511,172. Filed May 4, 1893.

A stenographic system of telegraphy.

Morse Transmitter, A. F. M. Cornaud, Brussels, Belgium, 511,234. Filed May 29, 1889.

A stenographic telegraph transmitter sending signals by the Morse code.

Telegraph Relay, E. P. Medina, San Francisco, Cal., 511,244, Filed May 4, 1891.

Telephones and Apparatus :—

Magneto Telephone, J. A. Brown, Moline, Ill., 511,118. Filed Aug. 16, 1893.

The method consists in producing a current in a coil by induction from a magnet by varying the contact of the core of the coil which constitutes a temporary magnet with the permanent magnet.

Two Station Telephone Circuit, F. A. Pickernell, Newark, N. J., 511,276. Filed Aug. 7, 1893.

PERSONAL.

MR. H. A. WAGNER.

MR. H. A. WAGNER, who has for so long been identified with the Missouri Electric Light and Power Company as its superintendent, has, upon the retirement of Mr. James I. Ayer from the Municipal Electric Light Company, assumed the office of general superintendent of this company also. In so doing, Mr. Wagner finds himself responsible for the affairs of two companies, one carrying 110,000 incandescent lamps and the other 4,000 arc lamps. Mr. Wagner also remains as general manager of the Wagner Electric Mfg. Company, and will continue to direct its affairs.

MR. W. J. HAMMER is to marry Miss Alice Maud White on January 3, at the residence of her parents, Mr. and Mrs. T. H. White, 1581 Euclid Avenue, Cleveland, O.

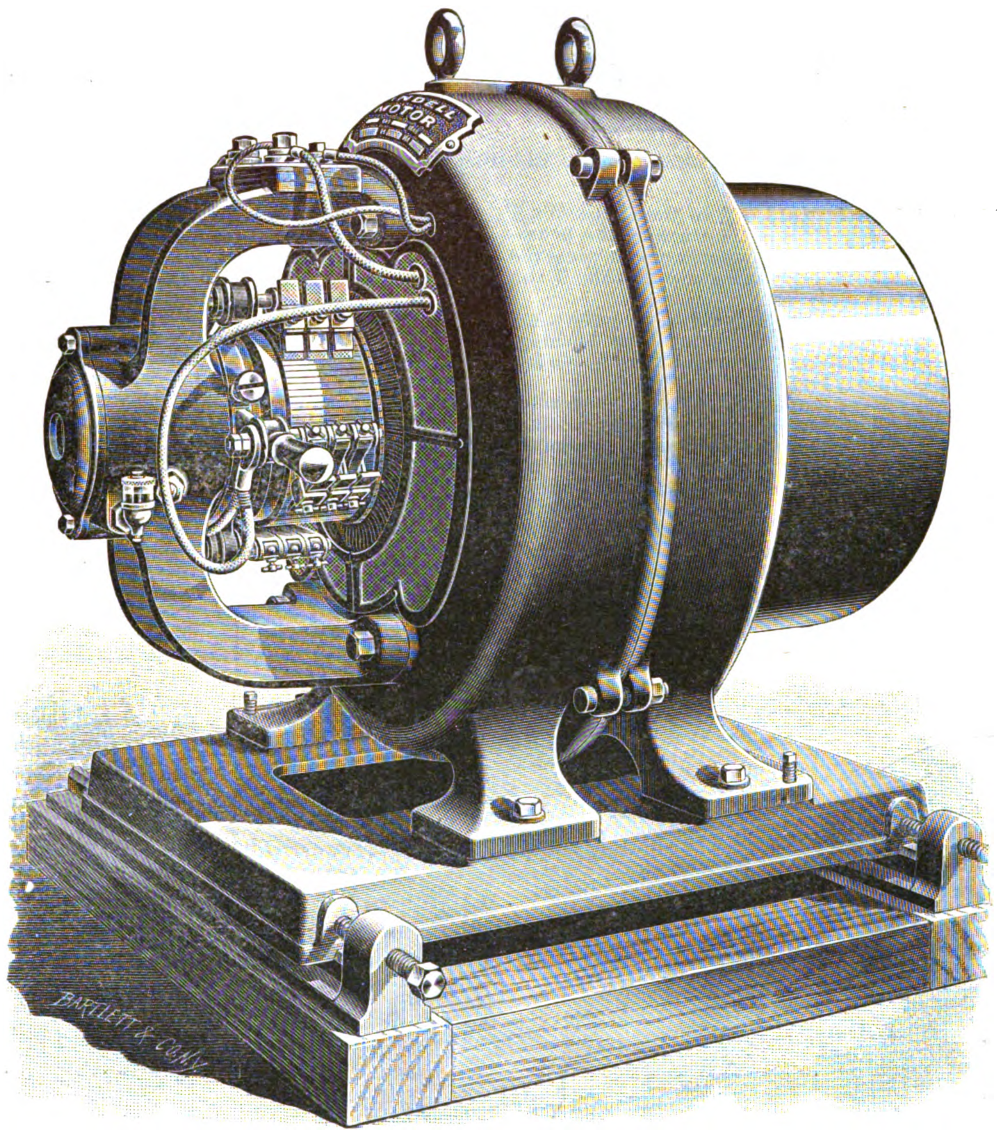
MR. HORATIO A. FOSTER, who is associated with Prof. George Forbes in this country, was married at Chicago on December 22, to Miss Florence Louise, daughter of Mr. and Mrs. Richard Root, of Keokuk, Iowa.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

LUNDELL DIRECT-CURRENT DYNAMOS AND MOTORS.

THE Lundell type of direct-current dynamos and motors is so simple that an elaborate description of the different parts seems to be unnecessary. The chief characteristics are embodied in the novel construction of the field-magnet, whereby a single energizing coil magnetizes all the pole-pieces and a strong protecting shell for the windings of both field and armature forms the magnetic circuit.



THE LUNDELL DIRECT CURRENT MOTOR AND DYNAMO.

The arrangement of the field-magnet and its energizing coil is clearly illustrated in the accompanying engravings.

It will be noted that the two field-magnet halves when bolted together form a shell which completely protects the armature, the whole of the shell being utilized in the magnetic circuit. These field-magnet halves are so designed that they are readily withdrawn from the mould in casting. The cross-section of the shell equals the cross-section of the base of the pole-pieces, so that no choking of the lines of force can occur at any point. Cast steel is employed for all these dynamos and motors. The single energizing coil not only reduces the construction of the machine to the simplest point, but by having only two terminals it is especially adapted to be placed in the hands of inexperienced users, as it avoids any possible mistake in connecting up or any delay or trouble in examination when such becomes necessary. Another feature of the design is that the pole pieces are magnetized directly, and the resistance of the magnetic circuit reduced to a minimum, whereby a considerable economy in the ampere turns of the energizing coil is effected.

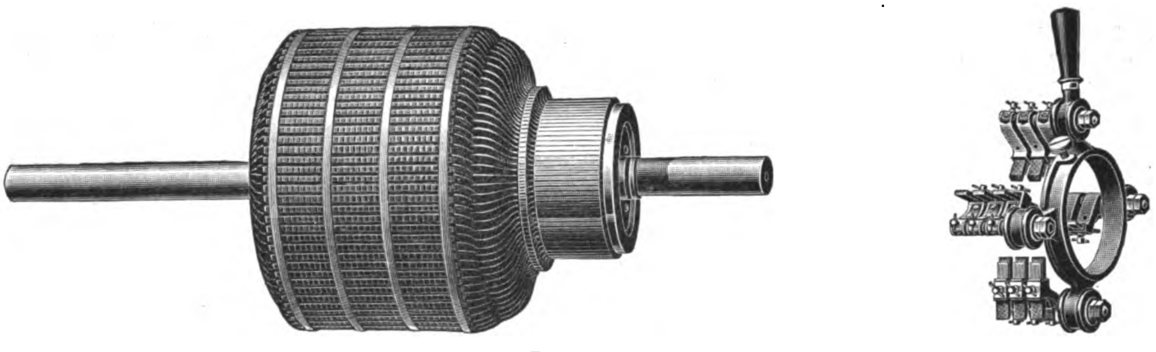
The armature adopted for these machines is of a modern Pacinotti form. This type of armature has in the past been subject to unfavorable criticism on account of the resultant heating of the pole-pieces, but it is now recognized that this heating was not due to the Pacinotti ring itself, but to the lack of knowledge with regard to its proper design. A little reasoning will show that when the ratio of the distance between the teeth and the magnetic gap is too small, a concentration of the lines of force will take place, so that the pole-pieces will be swept over alternately by sections of the highly concentrated lines of force, and by practically inert material. The result is that Foucault currents must inevitably be set up in the pole-pieces and cause the heating, which has been noted in the past. By so proportioning the teeth, however, that the lines of force emanating from the pole-pieces are more evenly distributed over their entire surface surrounding the armature, this abrupt demarcation is avoided, with the result that Foucault currents are also avoided in the pole-pieces.

The result of actual practice with the Lundell machine has shown the soundness of this theory, which is carried into practice by the employment of deep and narrow slots.

Notwithstanding the iron clad nature of the machine, the concentric position of the field-coil allows the armature to be withdrawn without disturbing either the field-coil or the pole-pieces.

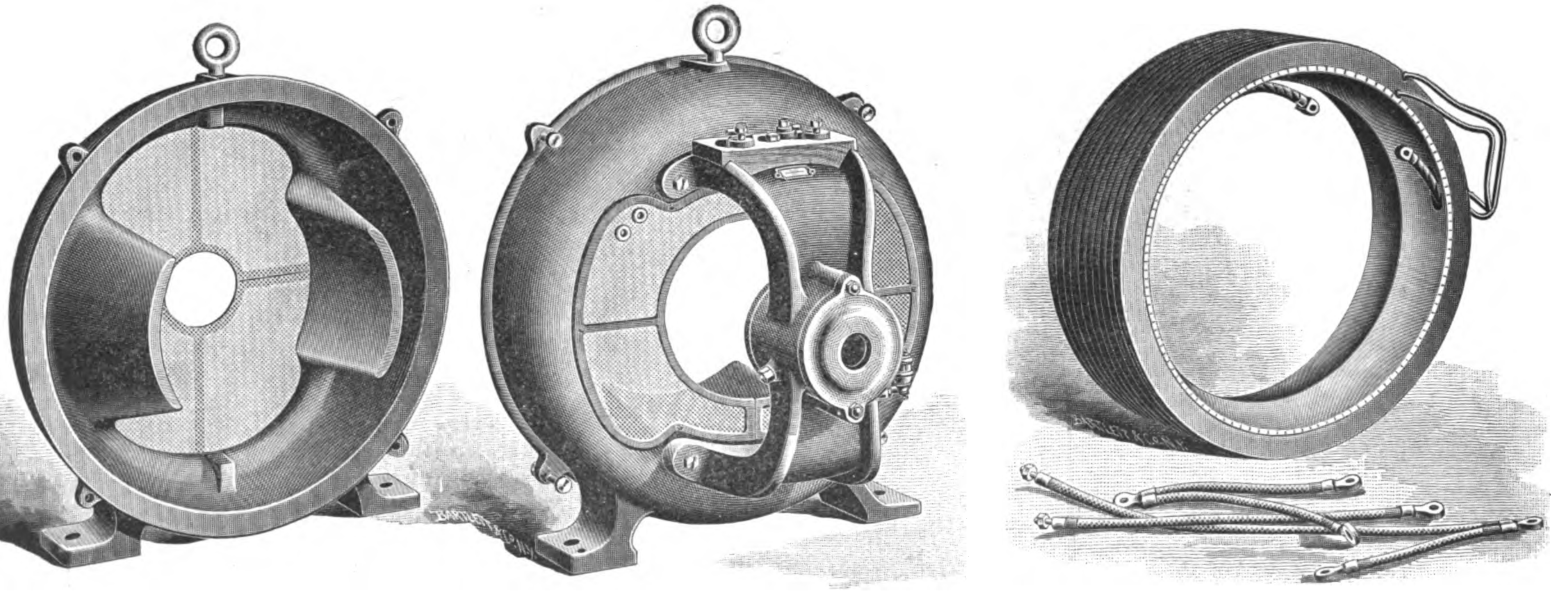
The openings around the armature at the ends of the field-magnets are, in the larger machines, covered with metal screens to protect the working parts, and to secure at the same time perfect ventilation. The commutator portion of the armature alone projects outside the screen, and is well protected by a strong bracket which carries the out-board bearing. The brushes are ranged diametrically around the commutator and the opposite brushes are in all four-pole machines connected together. They can be raised from the commutator when the machines are not in use.

The brushes of the two-pole type have a unique spring arrangement for pressing the carbon brushes against the commutator. The spring has its rear end placed in a curved slot at the end of a brush-holder; while its forward end in the shape of a T presses against the carbon which slides in the ways in the brush-holder. To remove the carbon, it is merely necessary to press the spring upwards out of the slot, which releases it so that the T can be withdrawn, and the carbon slides out.


Armature and Brushes, Lundell Dynamo.

The bearings are constructed with mechanical accuracy, are self-oiling and are provided with a vision gauge. The bushings are made of the best material and are so arranged as to be readily removed and renewed when worn out.

The oiling is accomplished by means of a number of rings which encircle the shaft and dip into the reservoir, thus continually feeding fresh oil to the bearing. In order that the attendant may know the exact condition of the oil, a simple device has been added, consisting of an elbow with an oil-chamber, rising slightly above the normal level of the oil. The vertical arm of this elbow is so arranged that when the visual gauge is half filled the bearing is properly oiled. The glass tube is made so short that by no possible inadvertency can the attendant pour in oil sufficient to flood the bearing and cause the oil to run out at the inner surface of the shaft and so go into the armature.


Field Magnet Halves and Magnetizing Coil, Lundell Dynamo.

The Interior Conduit & Insulation Co., manufacturers of the Lundell dynamos and motors, claim that their efficiency is as high as can be obtained by any first-class machine.

The Southern Pacific Railroad Company will build a new cotton shed at New Orleans, 120 feet wide and 350 feet long. They have placed the contract with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be entirely of iron, the sides being made with the Wilson patent rolling shutters.

QUEEN & CO.'S TACHOMETERS.

Queen & Co., Philadelphia, have an excellent portable tachometer, by means of which the speed of engines, dynamos and motors can be quickly and accurately determined. It is compact, convenient to handle, and will indicate revolutions up to 3,000 turns per minute. They also have stationary types for permanent attachment. In the economical operation of a lighting or power plant, it is highly necessary to run a dynamo very close to schedule speed, which can only be determined by an instrument such as the above.

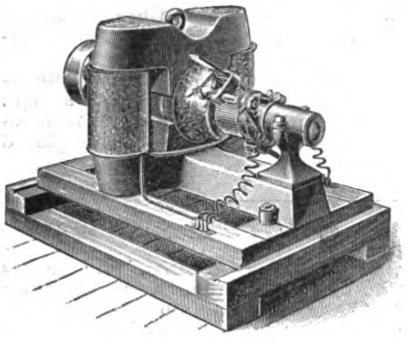
JOHN SCOTT MEDAL AWARDED FOR THE EDSON GAUGE.

The John Scott legacy medal and premium, held in trust by the city of Philadelphia under the legacy of John Scott of Edinburgh, to be used for the encouragement of "ingenious men and women who make useful inventions," provides for the distribution of a medal incribed, "To the most deserving," and money premium in the sum of $20, has just been awarded to Jarvis B. Edson of New York, for his pressure-recording gauge, by the Franklin Institute.

The general adoption of these valuable instruments proves their indispensable nature, for in no other way can a proprietor place himself in a position to know how the steam pressure is carried during night and day, or how much inattention accompanies the firing. As it is a well established fact that carelessness and indifference at the furnace door wastes coal in an amount often sufficient to pay an extra dividend, to say nothing of loss in the cylinder from lack of initial pressure and proper economy from expansion of the steam, for the firemen little understand the necessity for maintaining high initial pressure. "Following" too far or "cut-off" too short, are both wasteful of steam and can only be controlled by the fireman carrying uniformly such a pressure on the boilers as the engine requires for the work it has to perform.

It is equally evident that such records, similarly produced, are as valuable where compressed air, water or other fluids are desired to be maintained under prescribed degrees of pressure.

THE H. C. FISH MACHINE WORKS.



The Fish Dynamo.

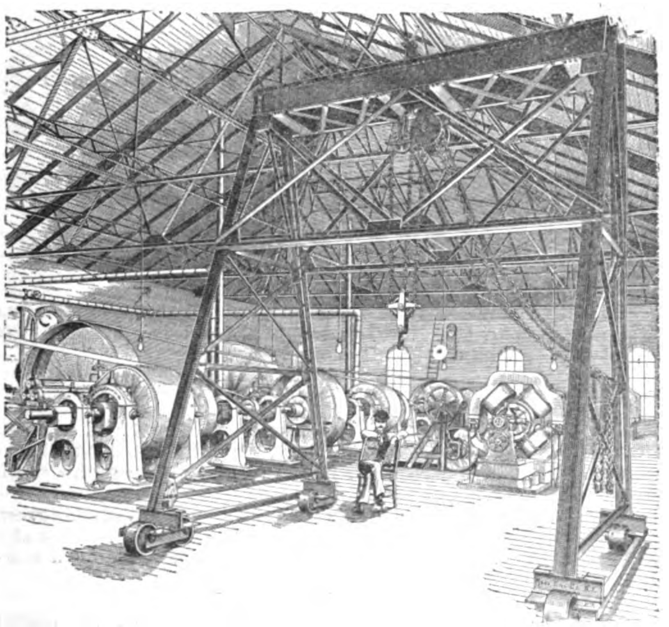
THE H. C. FISH MACHINE WORKS, of Worcester, Mass., have published a catalogue of their new electrical department. After a long time spent in experiment and thorough testing, they are now ready to place on the market electrical machinery of the highest class. The company have maintained an enviable reputation in other branches of business in past years, and expect to preserve that reputation in the future in this new branch.

The accompanying illustration shows the type of their machines ranging from four to eight kilowatts. They have large commutators and very strong fields, and are claimed to be entirely free from sparking. The bearings of the smaller sizes are of phosphor bronze and, in the larger, of compressed Babbitt metal in cast iron shells. These machines do not in any way greatly depart from ordinary accepted engineering practice, but they are claimed to embody all the favorable points possible which modern practice has found reliable. It is unnecessary to recite the points which are necessary to make a good machine as they are well known to all our readers. The company have now, in spite of the business depression, orders ahead for two months.

POWER HOUSE OF NEW ORLEANS AND CARROLLTON ROAD.

THE new electric plant of the New Orleans & Carrollton Railway Co., at New Orleans, La., consists of a car-shed and power-house, both designed and built by The Berlin Iron Bridge Company, of East Berlin, Conn.

The former is 128 feet in width and 300 feet in length. Light for the interior is secured through the side windows in the monitor, ventilation being provided for by means of louvers, the louvers and the windows alternating from panel to panel. The sides of the building for a distance of about 10 feet from the ground are left entirely open so as to admit of free access to the interior of the building. The ends of the car-house are also left open below the tie beams so that cars can be moved in and out without trouble. A building can be constructed in this way at New Orleans on account of the warm climate—it being unnecessary even in the coldest days to protect the interior or to provide for heat.

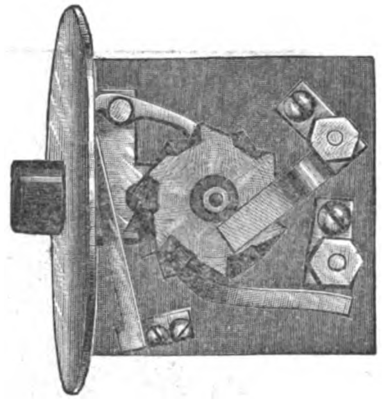


POWER HOUSE OF NEW ORLEANS AND CARROLLTON ROAD.

The power-house shown in the illustration has a construction similar to the car-shed, except that the side walls are of brick, the roof only being of iron. The particular feature, however, of this part of the plant is the portable crane shown in the foreground. This is so arranged that it can be easily moved to any part of the building, and is of sufficient capacity to raise and lower the machinery in and out of place. In the case of this power-house a traveling crane of the full width of the building would be an expensive matter. Owing to the general arrangement of the steam pipes and belts, this construction would be inexpedient and unadvisable. To meet this necessity the crane shown in the illustration was designed and built by The Berlin Company, and has proved a great success. The construction of both buildings is creditable both to the builders and the New Orleans Railroad Co.

"STANDARD" PUSH SWITCH.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, are introducing the latest novelty in switches, known as the "Standard" single push flush switch shown in the accompanying illustrations. The particular feature of the switch is that it is operated by only one button instead of by two as is the case in the ordinary construction of push switches. The advantage of this method of operation is readily apparent not only in the added neatness of the switch but in its simplicity of action.



"STANDARD" PUSH SWITCH.

The interior construction of the switch is shown in the cut. The action, which is readily apparent, is very positive and at the same time the switch can be manipulated with great ease. The break is quick and is made in such a manner that the switch cannot be left half off or on and a short circuit cannot occur.

The "Standard" single push switch is intended to take the place of any 5 or 10 ampere snap or flush switch, and is made in the regular 10 ampere single pole, and 10 ampere three way styles. A third style is now under way and will shortly be ready for the market, to be known as the "Standard" commutation switch. In general appearance it is the same as the regular switch shown here but the contacts are so arranged that a light or group of lights by the use of the commutation switch can be controlled from any number of points without extra wiring; that is, a light or group of lights can be turned on or off from any three or more points independently.

All of the "Standard" switches are very compact and neatly made, no money being spared to make them first-class in every respect. The price at which the Electric Appliance Company are placing them on the market is also very low. Large numbers have already been sold and the demand is rapidly increasing.

THE WESTERN TELEPHONE CONSTRUCTION CO.

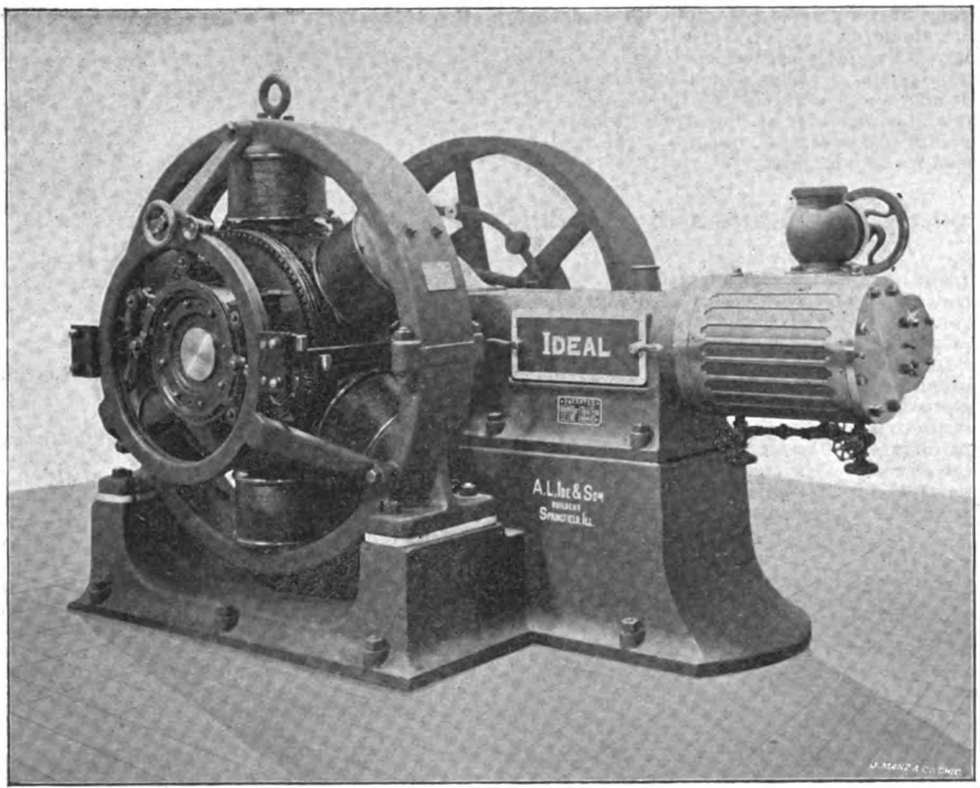
THE WESTERN TELEPHONE CONSTRUCTION CO., of 440 Monadnock Building, Chicago, who have been for the past year making preparations to enter the telephone field on a large scale as soon as the telephone patents had expired sufficiently to warrant them in so doing, will begin extensive operations on or about the first of next month.

This company, by purchase and otherwise have obtained control of some of the most valuable devices in telephonic apparatus, including everything necessary for the complete installation of first-class modern telephone exchanges, as well as complete outfits for cities, towns and villages, private lines or factory plants. They control nearly 100 patents, and contemplate dealing exclusively in telephonic apparatus.

Contracts will be made for the sale outright of the entire equipments or any portion of the apparatus necessary for a telephone plant and the company's factory facilities and financial recources make it possible for them to operate on an extensive scale. A number of large contracts have already been obtained.

ELECTRIC LIGHTING COMBINATION FOR THE SOUTHERN HOTEL, ST. LOUIS.

THE state of perfection at which the latest types of steam engines have arrived is shown in nothing so clearly as in the increased demand for automatic types of engines to be directly connected to dynamos. The fluctuations in load, especially in street car service, are so great and so numerous—fluctuations of 25 to 100 per cent. of the entire load, occurring almost instantaneously, that it has taxed the inventive genius of our engine builders to the utmost to produce engines that will stand the strain. In the case of belt-driven dynamos, a severe short circuit will usually cause the belt to fly off and thus relieve the engine, but a direct connected engine must not only be able to maintain a uniform speed under these sudden changes of load, but it must not fly to pieces if a short circuit brings the engine to a sudden stand-still.



IDE ENGINE COMBINATION PLANT IN THE SOUTHERN HOTEL, ST. LOUIS.

That the day of slow-speed engines with bursting fly wheels is past for electrical work is freely claimed. Where space is not very valuable, dynamos belted to high speed engines will continue to be used, but where space becomes a matter for grave consideration, the future demand must be for direct connected engines as soon as engine builders can supply a suitable engine.

To meet this demand, the engine shown in the accompanying cut has been built by A. L. Ide & Son, of Springfield, Ill. The illustration is taken from one of three ideal engines recently shipped by this firm for use in lighting the new Southern Hotel in St. Louis, Mo. Two of these engines had 14x14 cylinders, the third had a 13x12 cylinder. All were regulated to run at 275 revolutions. Each of these engines had a General Electric Co. armature keyed on the crank shaft in place of the plain pulley. The construction of the armature and engine are such that no outboard bearing is required. The two 14x14 engines are to drive dynamos belted from the governor pulleys in addition to the direct connected armatures.

The points of superiority claimed by the builders of these engines for this form are as follows: They claim that they will not vary over 1 per cent. in speed for a sudden change of 100 per cent. in load. They are perfectly self-contained and balanced. Every engine was adjusted before leaving the works to run at its specified speed under full load, and so balanced as to run without shaking with all anchor bolts removed. Excellence in workmanship and material—steel and bronze entering into its construction to an unusual extent. The engines are provided with the well-known Ideal system of self-oiling, which supplies all the working parts with a constant stream of oil that is used over and over again. There is positively no oil scattered in any direction. The armatures are therefore entirely free from any danger that could result from a splash of oil. That these engines are peculiarly adapted to work in places where space is valuable, will be apparent from those dimensions:

The 14x14 engines, with armatures attached complete as shown in the illustration, can be placed in a box 68 inches high, 81 inches wide, 10 feet and three inches long, and their rated horse power is 125. The 13x12 engine—100 h. p.—can be placed in a box 68x74x9 feet and 11 inches.

THE "WHITE PLUME" OF KERITE.

MR. W. R. BRIXEY is "nothing if not original," and he has just given another proof of his fertility of resource in presenting to the friends of "Kerite" a beautiful aluminum pen as a New Year memento. It is stamped out in the shape of an old-fashioned quill, and has the word "Kerite" in large letters on the plumage, together with the injunction to specify that insulation whenever any wire orders are to be given out. The pen is curiously bright, light and pretty, and will be warmly welcomed by every lucky recipient. We have no doubt that requests for an exemplar, sent to Mr. Ham, at the headquarters of Kerite, 203 Broadway, will be courteously complied with.

CHRISTMAS CALENDARS.

THE DIRECT U. S. CABLE CO. has issued a neat pad calendar from its headquarters at 40 Broadway. It is mounted on a handsome lithographed card, which shows Puck putting his girdle around the earth.

THE COMMERCIAL CABLE CO.'s staff has issued seasonable greetings in the shape of a fine picture of the "Vigilant" surrounded by a horseshoe. It is printed on heavy board, and is a work of art.

MR. S. A. DOUGLAS has resigned his connection with the Brush Electric Company whose Western manager he has been for some time past and has become general sales agent of the General Incandescent Arc Light Co., of 572 to 578 First Ave., New York.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVII. JANUARY 10, 1894. No. 297.

THE TESLA ELECTRICAL OSCILLATOR.

IN the lecture delivered before the Chicago Electrical Congress, Mr. Nikola Tesla first drew attention[1] to the method and means which he had devised for the continuous production of alternating currents of constant period in which all rotating parts are avoided by the employment of his oscillating engine directly to the movement of the generating coil in the magnetic field.

The main reason why no engine heretofore has been capable of producing results of this nature is that it has been customary to connect with the reciprocating parts a heavy fly-wheel or some equivalent rotary system of relatively very great inertia, or in other cases where no rotary system was employed, as in certain reciprocating engines or tools, no regard has been paid to the obtainment of the conditions essential to the end which Mr. Tesla had in view.

In applying the Tesla oscillator for the generation of currents of constant period certain conditions are encountered which must be taken into consideration in order to satisfactorily secure the desired result. When a conductor is moved in a magnetic field and a current caused to circulate therein, the electromagnetic reaction between it and the field might disturb the mechanical oscillation to such an extent as to throw it out of isochronism. This, for instance, might occur when the electromagnetic reaction is very great in comparison with the power of the engine, and there is a retardation of the current so that the electromagnetic reaction might have an effect similar to that which would result from a variation of the tension of the spring; but if the circuit of the generator be adjusted so that the phases of the electromotive force and current coincide in time, that is to say, when the current is not retarded, then the generator driven by the engine acts merely as a frictional resistance and will not, as a rule, alter the period of the mechanical vibration, although it may alter its amplitude. This condition may be readily secured by properly proportioning the self induction and capacity of the circuit including the generator.

Mr. Tesla has, however, observed the further fact in connection with the use of such engines as a means for running a generator, that it is advantageous that the period of the engine and the natural period of electrical vibration of the generator should be the same, as in such case the best conditions for electrical resonance are established and the possibility of disturbing the period of mechanical vibrations is reduced to a minimum. Mr. Tesla has found that even if the theoretical conditions necessary for maintaining a constant period in the engine itself are not exactly maintained, still the engine and generator combined will vibrate at a constant period. For example, if instead of using in the engine an independent cylinder and plunger, as an air spring of practically constant rigidity, the piston may impinge upon air cushions at the ends of its own cylinder. Although the rigidity of such cushions or springs might be considerably affected and varied by the variations of pressure within the cylinder, still by combining with such an engine a generator which has a period of its own, approximately that of the engine, constant vibration may be maintained even through a considerable range of varying pressure, owing to the controlling action of the electromagnetic system.

Indeed Mr. Tesla has even found that under certain conditions the influence of the electromagnetic system may be made so great as to entirely control the period of the mechanical vibration within wide limits of varying pressure. This is likely to occur in those instances where the power of the engine, while fully capable of maintaining a vibration once started, is not sufficient to change its rate.

In our issue of November 8, 1893, we gave the details of construction of the Tesla oscillator and a patent just issued to Mr. Tesla now enables us to supplement our previous descriptions with those of other types employed by him in this work. The accompanying engraving, Fig. 1, is a sectional view of an oscillator fulfilling the conditions laid down above.

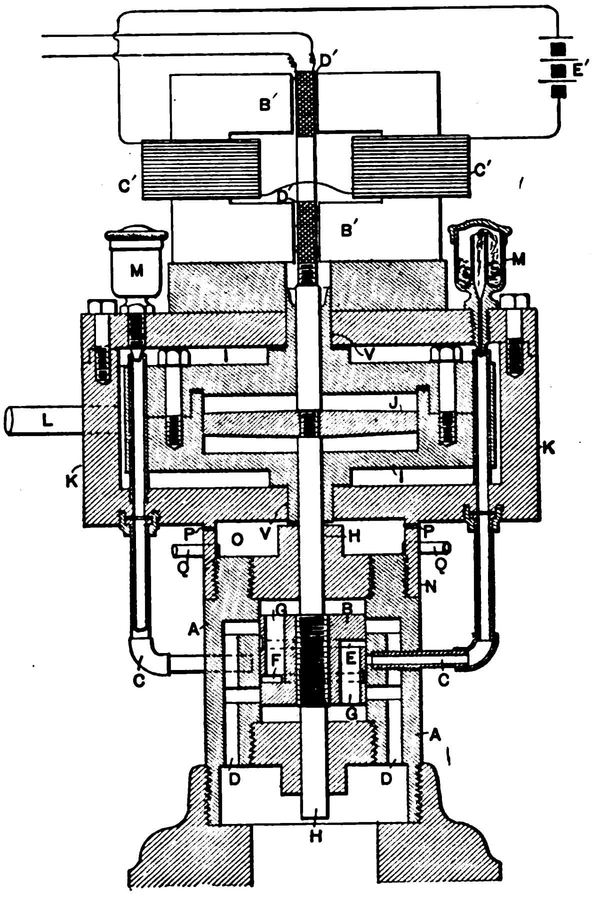


FIG. 1.—TESLA ELECTRICAL OSCILLATOR.

Referring to Fig. 1, A is the main cylinder in which works a piston B. Inlet ports C C pass through the sides of the cylinder opening at the middle and on opposite sides. Exhaust ports D D extend through the walls of the cylinder and are formed with branches that open into the interior of the cylinder on each side of the inlet ports and on opposite sides of the cylinder. The piston B has two circumferential grooves E F which communicate through openings G in the piston with the cylinder on opposite sides of the piston respectively.

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[1] See The Electrical Engineer, August 30, 1893.

The particular construction of the cylinder, the piston and the ports controlling it may be very much varied, and is not in itself material, except that in the special case under consideration it is desirable that all the ports, and more especially the exhaust ports, should be made very much larger than is usually the case so that no force due to the action of the steam or compressed air will tend to retard or affect the return of the piston in either direction.

The piston B is secured to a piston rod H which works in suitable stuffing boxes in the heads of the cylinder A. This rod is prolonged on one side and extends through bearings V in a cylinder I mounted in line with the first, and within which is a disc or plunger J carried by the rod H. The cylinder I is without parts of any kind and is airtight except as a small leakage may occur through the bearings V, which experience has shown need not be fitted with any very considerable accuracy.

The cylinder I is surrounded by a jacket K which leaves an open space or chamber around it. The bearings V in the cylinder, extend through the jacket to the outside air and the chamber between the cylinder and jacket is made steam or air-tight by a suitable packing. The main supply pipe L for steam or compressed air leads into this chamber, and the two pipes that lead to cylinder A run from this chamber, oil cups M being conveniently arranged to deliver oil into the pipes for lubricating the piston.

In the particular form of engine shown, the jacket K which contains the cylinder I is provided with a flange N by which it is screwed to the end of the cylinder A. A small chamber O is thus formed which has air vents P in its sides and drip pipes Q leading out from it through which the oil which collects in it is carried off.

In the position of the parts shown, or when the piston is at the middle point of its stroke, the plunger J is at the centre of the cylinder I and the air on both sides of the same is at the normal pressure of the outside atmosphere. If a source of steam or compressed air be then connected to the inlet ports C C of the cylinder A and a movement be imparted to the piston as by a sudden blow, the latter begins to reciprocate in the well-known way.

The movements of the piston compress and rarefy the air in the cylinder I at opposite ends, alternately. A forward stroke compresses the air ahead of the plunger J which acts as a spring to return it; similarly, on the back stroke the air is compressed on the opposite side of the plunger J and tends to drive it forward.

The compressions of the air in the cylinder I and the consequent loss of energy due mainly to the imperfect elasticity of the air, give rise to a very considerable amount of heat. This heat is utilized by conducting the steam or compressed air to the engine cylinder through the chamber formed by the jacket surrounding the air-spring cylinder, the heat thus taken up and used to raise the temperature of the steam or air acting upon the piston is availed of to increase the efficiency of the engine.

In any given engine of this kind the normal pressure will produce a stroke of determined length, and this will be increased or diminished according to the increase of pressure above, or the reduction of pressure below, the normal. In constructing the apparatus proper allowance is made for a variation in the length of stroke by giving to the confining cylinder I of the air spring properly determined dimensions. The greater the pressuse upon the piston, the higher will be the degree of compression of the air-spring, and the consequent counteracting force upon the plunger.

The rate or period of reciprocation of the piston, however, is mainly determined by the rigidity of the air spring and the inertia of the moving system, and any period of oscillation within very wide limits may be secured by properly proportioning these factors, as by varying the dimensions of the air chamber, which is equivalent to varying the rigidity of the spring, or by adjusting the weight of the moving parts. These conditions are all readily determinable, and an engine constructed as above described maintains a perfectly uniform period through very wide limits of pressure.

The pressure of the air confined in the cylinder when the plunger I is in its central position will always be practically that of the surrounding atmosphere, for while the cylinder is so constructed as not to permit such sudden escape of air as to sensibly impair or modify the action of the air-spring, there will still be a slow leakage of air into or out of it around the piston rod, according to the pressure therein, so that the pressure of the air on opposite sides of the plunger will always tend to remain at that of the outside atmosphere.

To the piston rod H is secured a coil D′ which, by the movements of the piston, is oscillated in the magnetic field produced by two magnets B′ B′ which may be permanent magnets or energized by coils C′ C′ connected with a source of continuous current E′. The movement of the coil D′ across the lines of force established by the magnets gives rise to alternating currents in the coil. These currents, if the period of mechanical oscillation be constant will be of constant period.

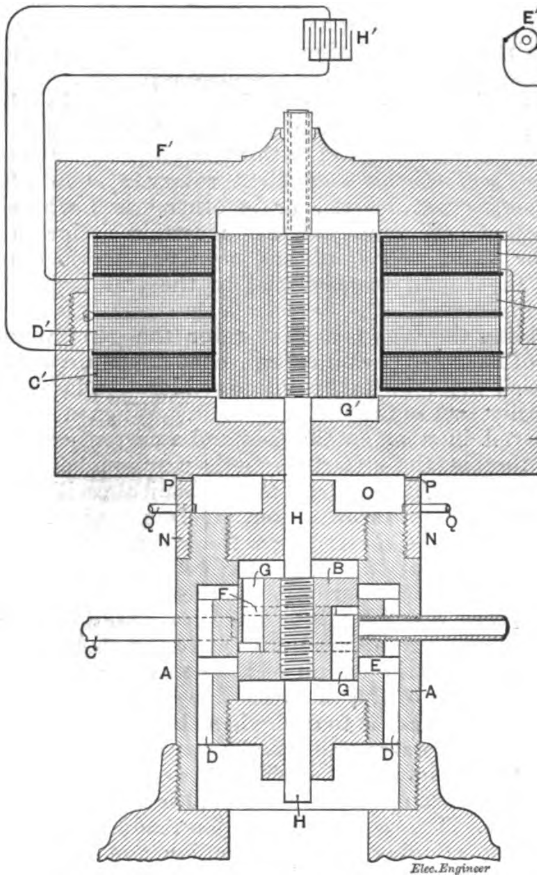


FIG. 2.—TESLA ELECTRICAL OSCILLATOR.

In the case under consideration it is assumed as a necessary condition that the inertia of the movable element of the generator and the electromagnetic reaction which it exerts will not be of such a character as to materially disturb the action of the engine.

Fig. 2 is an example of a combination in which the engine is not of itself capable of determining entirely the period of oscillation, but in which the generator contributes to this end. In this figure the engine is the same as that shown in Fig. 1. The exterior air spring is however omitted and the air spaces at the ends of the cylinder A relied on for accomplishing the same purpose. As the pressure in these spaces is liable to variations from variations in the steam or gas used in impelling the piston they might affect the period of oscillation, and the conditions are not as stable and certain as in the case of an engine constructed as in Fig. 1. But if the natural period of vibration of the electric system be made to approximately accord with the average period of the engine such tendencies to variation are very largely overcome and the engine will preserve its period even through a considerable range of variation of pressure.

The generator in this case is composed of a magnetic casing F′ in which a laminated core G′ secured to the piston rod H is caused to vibrate. Surrounding the plunger are two exciting coils C′ C′, and one or more induced coils D′ D′. The coils C′ C′ are connected with a generator of continuous currents E′ and are wound to produce consequent poles in the core G′. Any movement of the latter will therefore shift the lines of force through coils D′ D′ and produce currents therein.

In the circuit of coils D′ is shown a condenser H′. By the use of a proper condenser the self-induction of this circuit may be neutralized. Such a circuit will have a certain natural period of vibration, and, as this depends upon the capacity and self induction, the period may be varied to approximately accord with the period of the engine.

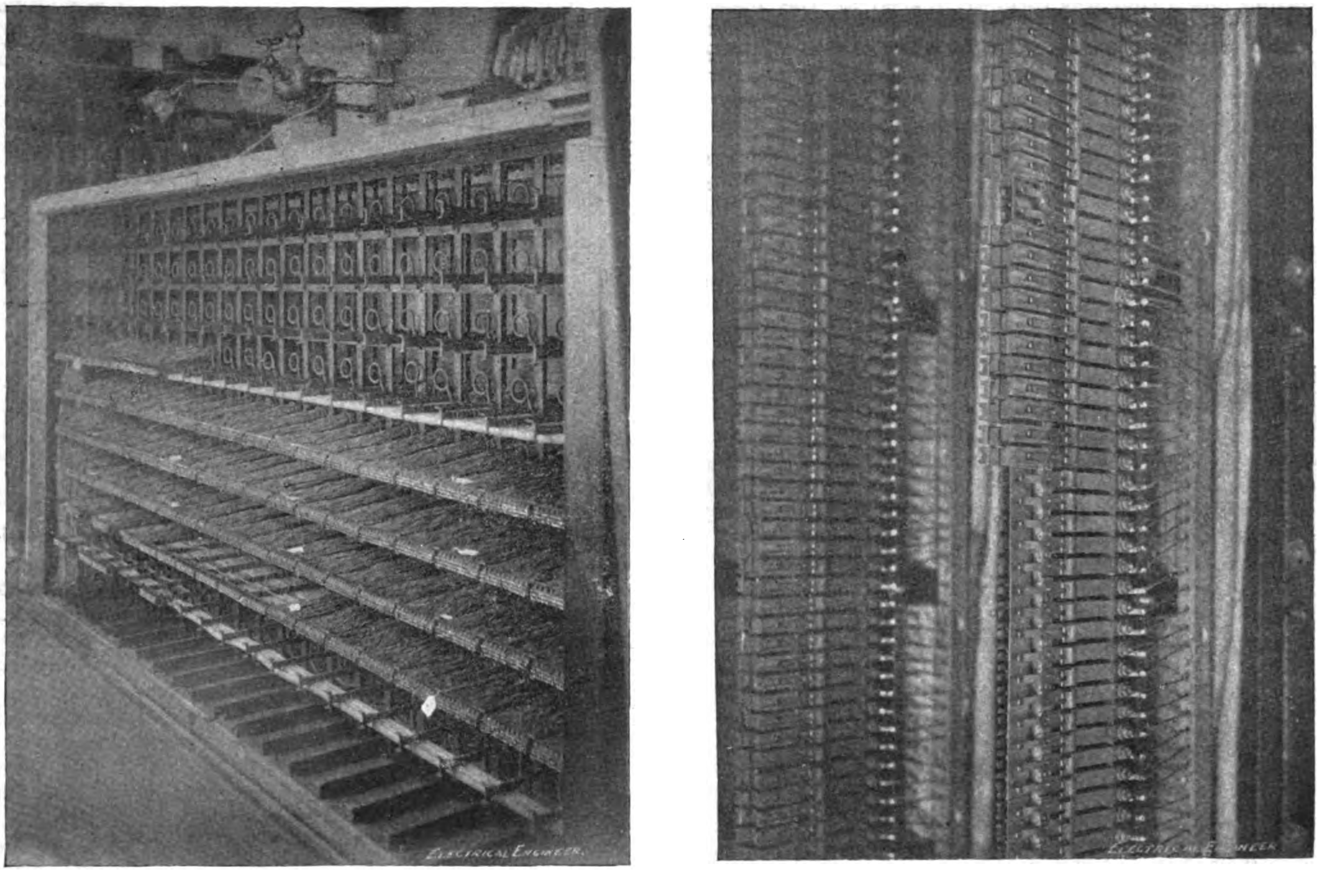
In case the power of the engine be comparatively small, as when the pressure is applied through a very small fraction of the total stroke, the electrical vibration will tend to control the period, and it is clear that if the character of such vibration be not very widely different from the average period of vibration of the engine under ordinary working conditions that such control may be entirely adequate to produce the desired results.

THE NEW BROAD STREET TELEPHONE EXCHANGE IN NEW YORK.

The Broad Street Exchange is the eighth central office that the Metropolitan Telephone and Telegraph Company has established in New York City below the Harlem River. It serves the financial and importing district bounded by Wall street and Broadway, from Wall street to the Battery. At present it contains some eleven hundred subscribers and has an actual capacity for 1,500 lines, and an ultimate capacity for 3,000 lines

The entire building and its electrical equipment represent in every detail the latest and most up-to-date development of telephone engineering. The building is fireproof, and was constructed especially for telephone purposes; it is the fourth of its kind erected by the Metropolitan Company, the other three being at Cortlandt, Spring and 38th streets. The subscribers' lines enter the building through the basement, 55 cables being led in from the subways, each cable containing 50 pairs of conductors. The cables are taken up a shaft in the northerly wall of the building to the terminal room on the seventh story, which is entirely occupied by the different departments of the telephone exchange. In the terminal room the cable heads are mounted on iron racks, and connection is made by means of a cross-connecting frame, between the subscribers' lines and the switchboard cables. At this point the lightning and strong-current protectors are inserted in the circuit; the protectors are carried on special attachments at one side of the distributing rack. They consist of air space cut-outs, which ground the line when the pressure reaches 300 volts, and strong-current protectors which fuse within 30 seconds under the influence of a current of .28 ampere. These appliances efficiently protect the switchboard apparatus against any possibility of damage from foreign currents.

In the terminal room is placed the generating plant

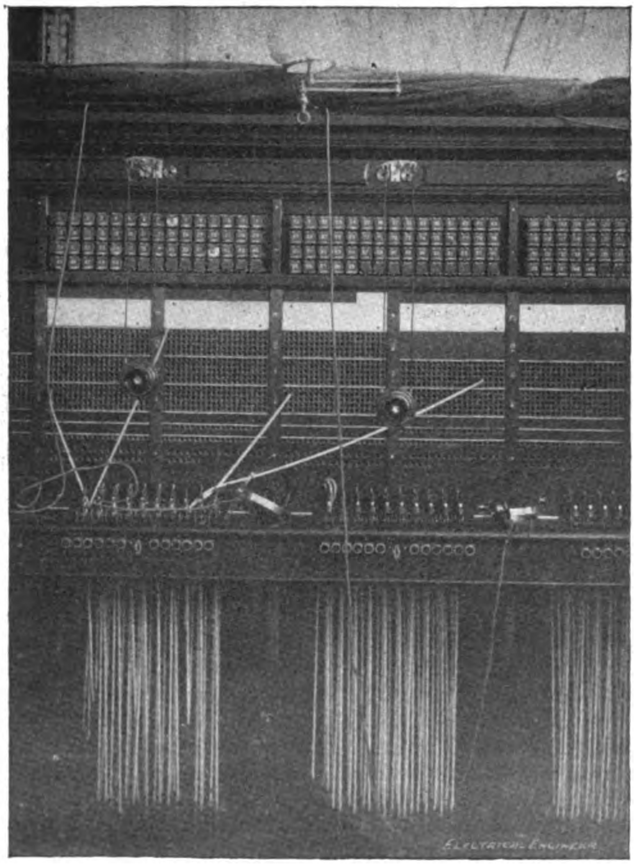


THE DISTRIBUTING RACK AND LIGHTNING ARRESTERS AT THE NEW BROAD STREET TELEPHONE EXCHANGE, NEW YORK.

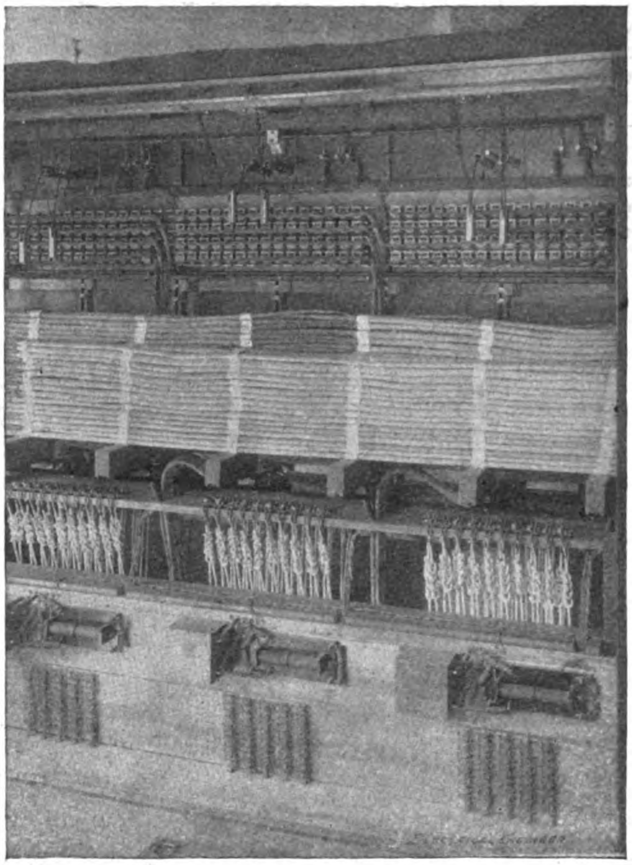
which furnishes current for ringing the subscribers' bells, for operating the switchboard transmitters and the busy signals, and for the relays used in testing the lines. No primary batteries are used in the exchange for any purpose. The ringing current is furnished by motor generators which receive a direct and deliver an alternating current to a circuit connected to the operators' ringing keys on the switchboard, the two windings being on the same armature. The relay current is supplied by a small direct current motor generator and another larger machine of the same type is used for charging the storage batteries by which the switchboard transmitters and the busy signal are operated. The desk of the wire chief, equipped with apparatus for testing lines, occupies one corner of this room.

In the operating room proper is the intermediate distributing rack at which the connections between the answering jacks and line drops and the subscribers' lines are made. This rack takes the place of the intermediate distributing board that was formerly placed at the back of the switchboard itself, and provides a very much more convenient system of effecting the necessary grouping and interchanging of subscribers' lines with reference to the switchboard.

The switchboard itself is of the type known as the "bridging" board, in which all the spring jacks and annunciators are connected in bridge or multiple arc. This preserves the balance of the line in the switchboard. The "busy" signal is effected by means of a circuit entirely distinct from the subscribers' wire; this circuit is normally open, but is closed by a collar on the plug when a connection is put up, current then being thrown on the corresponding spring jacks in the other sections of the board. The indicator drops, both line and clearing out, are of the self-restoring pattern. The line drop is restored by a locking coil that is energized when the operator inserts her plug in the answering jack, and the clearing-out drop is restored in a similar way by the depression of the listening key when the operator cuts in to make sure that the connection is to be taken down. The self-restoring drops relieve the operator of two movements in handling a connection, and are therefore quite a factor in increasing the rapidity of the service.



Front View of the Switchboard.



Rear View of Switchboard Showing Induction Coils.

In general appearance the switchboard is a noticeable improvement over that of the type of a few years ago. It is more compact in every way and has altogether a less overpowering air of complication. The amount of wiring and connections at the back of the board is less than it formerly was, owing to the concentration of the intermediate distributing board in one place. The switchboard transmitters are of the "solid back" type, with the metal case in a dull finish to avoid dazzling the eyes of the operators; the induction coils are placed at the back of the board.

The operating room is extremely spacious, and the whole of the switchboard is in sight at any point in the room. The manager's desk and that of the monitor operator, both equipped with lines running to various parts of the board, are placed about halfway down the room and from them an unobstructed view can be obtained of the entire switchboard and operating force. A large room looking out on the East River is provided for the use of the operators when off duty. This room is handsomely fitted up with tables, chairs, couches, lockers, refreshment urns and all possible arrangements for the comfort of the operators.

The equipment of the Broad Street Exchange has been carried out jointly by the Western Electric Company and the Metropolitan Telephone Company, the latter having done far more of the work than has usually been the practice of telephone companies in regard to such installations. The switchboard was constructed and equipped by the Western Electric Company, as were also the intermediate distributing board and protector rack. The rest of the work, including the desks of the wire chief, monitor operator and manager, the generating plant, the underground cable plant and wiring and many minor details, was carried out by the staff of the Metropolitan Company, the entire job being governed by the plans and specifications of the engineering department. The thoroughly workmanlike and shipshape appearance of all departments of the exchange reflects great credit on the staffs of both companies.

The transfer of subscribers from Cortlandt to Broad was begun on Saturday afternoon, December 30, and completed on the following day. On the first day of the year the new office was completely ready for business, but there was absolutely no business to do; the exchange was almost as quiet as an empty church. On the following day, however, the traffic was exceptionally heavy and lasted at high pressure until unusually late in the day. Both operators and apparatus stood the strain well; even to a practiced observer there was nothing to indicate that the office had not been working for a year and a day instead or for a day only, and in spite of the severity of the test no single case of "trouble" was developed in any part of the system.

On the afternoon of Jan. 3 a large number of visitors inspected the new exchange at the invitation of the Metropolitan Telephone and Telegraph Company.

THE WESTINGHOUSE PLANS FOR THE NIAGARA CONTRACT.

THE work now being done in connection with the electrical utilization of Niagara is attracting universal attention, and public interest has again been greatly stimulated by the paper read before the English Institution of Electrical Engineers, by Prof. George Forbes, and reprinted and discussed in our pages. We now have the pleasure of printing a very important communication on the subject from Mr. L. B. Stillwell, electrical engineer of the Westinghouse Electric and Manufacturing Company, signed by him on behalf of the company.

"We have read the leading editorial on 'The Niagara Project' in THE ELECTRICAL ENGINEER of December 20th, and note with interest the following:

> It was hardly to be expected that the promoters of the Niagara enterprise would accept the individual opinion of any one man on the various points of prominent importance, which had to be considered, and Prof. Forbes' paper may therefore be looked upon as a fair representation of the views of the most advanced electrical engineers, as well as the results of Prof. Forbes' own careful study of the literature on the subject and information gained from other sources. The paper may thus be considered not less an expression of the author's personal opinion than an epitome of the views of a large number of prominent electrical and mechanical engineers, and, as such, it will be of interest to determine in how far these views have been applied at Niagara.

"The fact that the engineers and electricians of the Westinghouse Electric and Manufacturing Company have for several years devoted much attention to the subject of power transmission is well known, as is also the fact that our company has received from the Cataract Construction Company the order for the initial installation of electrical apparatus at Niagara. It seems, therefore, a fair inference that you intend to include the engineers of this company among the electrical engineers of whose views you assume that Prof. Forbes' paper is a fair representation.

"The system which has been adopted for the installation at Niagara Falls is simply the Tesla polyphase system as developed by the technical staff of the Westinghouse Electric and Manufacturing Company. It has not been modified in any particular by the engineers of the Cataract Construction Company or of the Niagara Falls Power Company. It is fully described in publications of this company and was demonstrated on a large scale by one of our exhibits in the Electricity Building at the recent Columbian Exposition in Chicago. In developing and perfecting the system, we have not only been guided by a wide experience in the design, manufacture and use of electrical machinery but we have carried out a large amount of experimental work, much of it on an extensive scale, and have made a careful, theoretical and practical study of the subject. Prof. Forbes' views, as stated in his paper, are naturally in accord with ours upon many points. In others, his paper fails to fully state the facts as we see them, and, in others still, we think his views are incorrect. We cannot, therefore, in justice to our company, consent to the assumption that his paper be accepted as a "fair representation" of our views.

"Some of the technical journals have apparently received the impression that the generator described in Prof. Forbes' paper under the heading "General Description of a 5,000 H. P. Alternator" is that which has been adopted by the Cataract Construction Company. This is not the case. The drawings and specifications of the generator, which Prof. Forbes describes were laid before us in August last, and were fully explained by Dr. Coleman Sellers and Prof. Forbes. After careful consideration, we accepted the general mechanical features of the construction proposed as excellent, but, in the opinion of our electricians and engineers, the electrical features—the method of winding, the insulation, etc.—were impracticable, and realizing that we could not undertake the construction of such a machine with credit to our company, we declined to submit proposals. We were thereupon requested by the officers of the Cataract Construction Company to submit our own plans and specifications and this was done early in August. We followed closely the mechanical features approved by Dr. Sellers but the electrical features are wholly our own. These plans were accepted by the Cataract Construction Company and are those under which the generators for Niagara are now being constructed.

"Prof. Forbes is undoubtedly qualified to speak with authority as to the assumptions and reasoning which have led him to agree with other engineers of the Cataract Construction Company in recommending to his Board of Directors the adoption of the system, which has been selected, but the premises and the reasoning which guided the engineers of the Westinghouse Electric and Manufacturing Company in the development of the Tesla polyphase system, as it will be used at Niagara, differ widely in some respects from those which are set forth in the paper to which your editorial refers.

"We trust that you will give to this explanation suitable prominence as we are unwilling, for the reasons stated, to have Prof. Forbes' paper accepted by your readers as a statement of our views."

THE BUCKEYE LAMP WITHOUT LEADING-IN WIRES.

The Buckeye Electric Co., of Cleveland, have just brought out a most ingenious and novel form of incandescent lamp, which they consider entirely non-infringing, while possessing all the virtues and good qualities of the old, well known Buckeye. It is intended to avoid, among other things, the drawbacks of the so called "gas" lamps, and the objections due to the use of a resinous seal. The features of the lamp may be briefly enumerated as follows:—It consists, first, of an all glass globe and has a perfect vacuum, as so understood in lamp parlance. The familiar Buckeye filament is used in it. It contains no platinum whatever. Most striking of all, it has no leading in wires through the glass. As a matter of fact, the glass stem to which the filament is attached is so treated in the process of manufacturing the lamp as to form in itself an electrical conductor or bridge between the outside and the inside of the lamp. This lamp is now being made in large quantities for the market, and seems to us likely to command a large amount of attention.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—II.

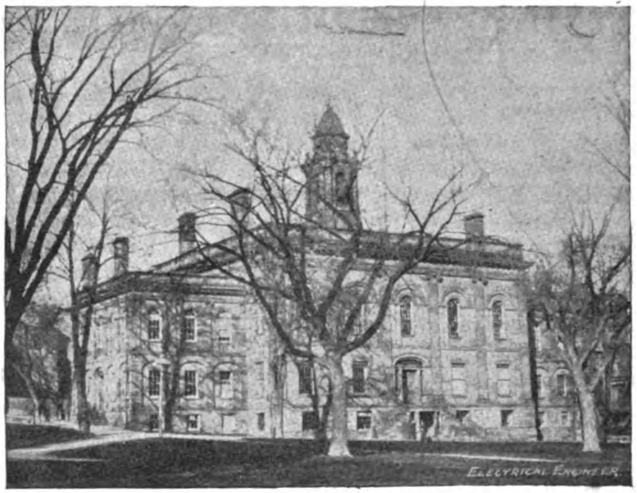
BY

Mary A. Henry

BARLOW was right, the electro-magnetic telegraph was impossible when he made his discouraging assertion in regard to its impracticability. At the time he made that declaration a telegraph founded upon the electro-magnet was bound to be a failure, for the electro-magnet was not the instrument which could meet the demands for the telegraph, until Henry had taken it up and turned it into the sensitive magnet, which could respond to electrical influence at a distance. Until this instrument was made by Henry, the electromagnetic telegraph was an impossibility. The experimental telegraphic efforts founded upon electro-magnetism *prior to Henry's discoveries*, constituted a third era in the history of the telegraph They began shortly after Oersted's discovery that a magnetic needle was deflected when a wire, through which a galvanic current was passing was held above it. Schweigger of Halle, as we know, extended the discovery of Oersted, by bending the wire in several convolutions around the needle, increasing in this way the effect of the current and producing greater deviation of the needle. On this principle he made what is called his "multiplier," or the galvanometer. We give a sketch of it as it is represented in various electrical books—a wooden frame, the magnetic needle within it free to move, and around the frame several convolutions of the wire conducting the electrical current; we will have occasion to refer to the instrument again in this chapter. La Place was the first to suggest that the deflecting power of the electric current might be employed for telegraphic purposes and Ampere was the first to propose a plan for the practical application of this idea; then followed many very interesting attempts to make the moving needles speak for man at a distance. But the action of the wire transmitting the electrical current, which was coiled around the needle and necessary to move it, depended upon the same law which controlled the action of the electro-magnet. This law had not been discovered; was to be discovered by Henry Soon it was found that the deflection of the needles, like the action of the magnet, decreased with the increase in length of the galvanic circuit; the electromotive power failed to act at any great distance. How curious it is to see all these telegraphic efforts—whether founded upon static or frictional electricity, galvanism or electromagnetism, all starting with brilliant eclat, winning deserved admiration, all meeting the same fate, coming to the same apparently insurmountable obstacle,—the failure of the electric force. Some of them were actual working telegraphs, in the sense that they conveyed intelligence at short distances; eight, ten, even twenty miles perhaps, but as regards what in contradistiction to them we have called *the telegraph*, with which man might encircle the world, what did they do? They each and all in various ways only confirmed the same fact, that electricity might be made to produce mechanical effects, which could be used as telegraphic signals. They did not solve the problem how electricity could be made to produce these effects at a distance. They provided ingenious methods for the delivery of the message but did not secure the messenger. The Spirit of the storm was not yet bound to this service.

Sturgeon's magnet had been in his cabinet for four years when young Henry took it up; but, before we see what he did with it, it may not be amiss to follow the steps which led him to it. Let us go back to the year 1824, when it grew into being under Sturgeon's hands, and on the evening of October 30th of that year look into a room in the Albany Academy, where the Albany Institute is holding one of its regular meetings.[1] The president of the Society is the Patroon of Albany, Gen. Van Rensselaer, and as he is very regular in his attendance on its meetings we may suppose he is present on this particular occasion. He regards with paternal interest a young man of twenty-four years, who is delighting the assembly with some experiments designed to illustrate the "*great reduction of temperature in steam of high elasticity when suddenly expanded.*" Very attractive is the young man as he stands there, tall and slender, his intellectual and unusually handsome face flushed with enthusiasm.

He ends his lecture by boldy thrusting his hand into a jet of steam issuing from the stop cock of a copper boiler before him, to exhibit the curious paradox, that, at a prescribed short distance from its escape, steam will not scald provided *it is hot enough*. This was Henry's first communication to the Albany Institute. Were we to seek the same room a year later, on the evening of March 2d, 1825, we would find the young man again delighting the assembly with his experiments—this time on "the production of cold by the rarefaction of air"—producing a veritable snow storm within six feet of a large stove, and in a room at a temperature not less than eighty degrees Fahrenheit; while perhaps outside on that March night, Nature was producing the same phenomenon on a large scale.[2]



THE ALBANY ACADEMY.

It was through Henry's great facility and pleasure in experimental illustration that he entered the field of science. In 1826 he was appointed Professor of Mathematics and Natural History in the Albany Academy. We have seen him exercising his ingenuity in devising experiments to illustrate his lectures before the Albany Institute; it was in connection with like efforts to exhibit strikingly to his pupils in classes the principles of electro-magnetism, that he made his first contribution to a science which, if we count from Oersted's experiments as its beginning, was at this time six years old. Not much had been done with the subject in America, Henry says, in a paper read before the Albany Institute, Oct. 10, 1827:

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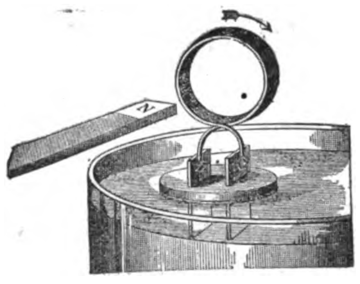
[1] (This society had only recently been established by the union of an oluer one for the "Promotion of Useful Arts in the State of New York," organized Feb., 1791, and the "Albany Lyceum of Natural History," formed and incorporated April 23d, 1825.)

[2] Half a pint of water was poured into a strong copper vessel, of a globular form, and having a capacity of five gallons; a tube of one-fourth of an inch diameter, with a number of holes near the lower end, and a stop-cock attached to the other extremity, was firmly screwed into the neck of the vessel; the lower end of of the tube dipped into the water but a number of holes were above the surface of the liquid, so that a jet of air mingled with with water might be thrown from the fountain. The apparatus was then charged with condensed air, by means of a powerful condensing pump, until the pressure was estimated at nine atmospheres. During the condensation the vessel became sensibly warm. After permitting the apparatus to cool down to the temperature of the room, the stop-cock was opened; the air rushed out with great violence, carrying with it a quantity of water, which was instantly converted into snow. After a few seconds, the tube became filled with ice, which almost entirely stopped the current of air. The neck of the vessel was then partially unscrewed, so as to allow the condensed air to rush out around the screw; in this state the temperature of the whole interior atmosphere was so much reduced as to freeze the remaining water in the vessel."—*Trans. Albany Institute*, Vol. 1, part 2, p. 36.

Although the principle on which this striking result was based was not at this time new, this particular application of it by Henry, thus publically exhibited, was long before any of the numerous patents were obtained for ice-making, not a few of which adopted substantially the same process.

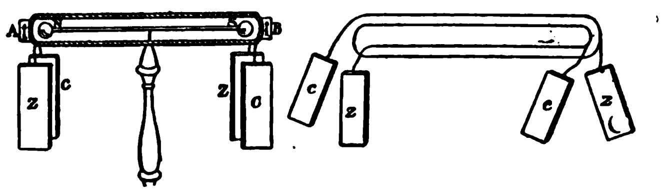
"The subject of electro-magnetism, although one of the most interesting branches of human knowledge, and presenting at the same time the most fruitful field for discovery, is perhaps less generally understood in this country than almost any other department of natural science. Our popular lecturers have not availed themselves of the many interesting and novel experiments with which it can so liberally supply them; and, with a few exceptions, it has not, as yet, been admitted as a part of the course of physical studies pursued in our higher institutions of learning. A principle cause of this inattention to a subject offering so much to instruct and amuse is the difficulty and expense which formerly attended the experiments—a large galvanic battery with instruments of very delicate workmanship being thought indispensible." Sturgeon had helped to obviate this difficulty. He had greatly improved lecture room apparatus for illustrating the electromagnetic reactions of rotation, etc. (where a permanent magnet is employed), by introducing stronger magnets and had thereby succeeded in exhibiting the phenomena on a larger scale and with less battery power. He was for this awarded the silver medal of the Society for the Encouragement of Arts. Henry, after repeating all the experiments of Oersted, Ampere and others, was, from his own experimental investigations, enabled to exhibit to his classes all the illustrations of Sturgeon on a much larger scale; with weak magnets, if necessary, and with still less battery power. These striking results were obtained by a simple expedient. Look again at Schweigger's multiplier. [See figure] Henry recognized the principle involved, viz., that in coiling the wire of a galvanic circuit the strength of the electrical current is increased, and in every case where a single wire circuit had been employed, he used a manifold coil of wire. By means of this coil Schweigger's multiplier became in Henry's hands an instrument of much greater delicacy and power; and Henry was not only able to produce with it more striking effects than Sturgeon had produced, but an apparatus capable of exhibiting phenomena of which Sturgeon's instruments were incapable. Henry says in his paper: "Mr. Sturgeon's suite of apparatus, though superior to any other as far as it goes, does not however form a complete set; as indeed it is plain that his principle of strong magnets cannot be introduced into every article required and particularly in those intended to exhibit the action of the earth's magnetism on a galvanic current, or the operation of two conjunctive wires on each other. To form therefore a set of instruments, on a large scale, that will illustrate all the facts belonging to this science, with the least expense of galvanism, evidently requires some additional modification of apparatus and particularly in those cases in which powerful magnets cannot be applied."

Schweigger's Multiplier.



De la Rive's Floating Ring.

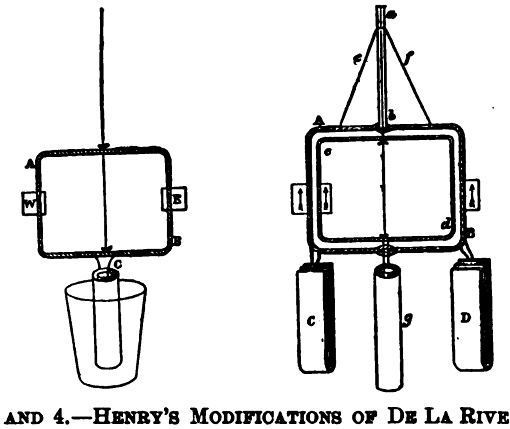
"In a paper published in the Transactions of the Albany Institute, June, 1828, I described some modifications of apparatus intended to supply this deficiency of Mr. Sturgeon by introducing the spiral coil on the principle of the galvanic multiplier of Prof. Schweigger, and this I think is applicable in every case where strong magnets cannot be used. The coil is formed by covering copper wire, from $\frac{1}{40}$ to $\frac{1}{80}$ of an inch in diameter with silk; and in every case which will permit, instead of using a single conducting wire, the effect is multiplied by introducing a coil of this wire closely turned upon itself."



Figs. 1 and 2.—Henry's Modification of Schweigger's Multiplier.

"The following description will render my meaning sufficiently clear:"

"Fig. 1, is an apparatus on the plan of the Multiplier, to show the deflection of a large magnetic needle. It consists of a coil of wire, A B, of an oblong form, about 10 inches in length and one and a half in width, with a small galvanic element attached to each end; the coil is formed of about twenty turns of fine copper or brass wire wound with silk, to prevent contact, and the whole bound together so as to have the appearance of a single wire. The attachment of the zinc and copper is more plainly shown in Fig. 2, which represents a coil of only two turns of the wire; on the left side of the figure the plates are soldered directly to the ends of the wire of the coil; on the right, the plate of zinc *z* is attached to the part of the wire ending with copper on the other side, while the plate of copper on the right corresponds to the zinc on the left. By this arrangement we can instantly reverse the direction of the currents and deflect the needle either to the right or left, by merely holding a tumbler of acidulated water so as to immerse one or the other of the double plates into the fluid. The arrows at A and B, formed of two pieces of card, are intended to show the direction of the currents, and they should point in the course of the wires going from the copper. N S, is the needle, about nine and a half inches long, made by binding together several watch springs, touched separately, so as to form a compound magnet; at the end are two balls of pith, to show the movement of the needle more plainly. This instrument is complete in itself, and we receive the full effect of the instantaneous immersion of the galvanic element."



Figs. 3 and 4.—Henry's Modifications of De La Rive's Ring.

To show the advantage of the coil, take the little instrument called "De la Rive's ring," a modification of Ampere's ingenious and delicate experiment for showing the directive action of the earth as a magnet on a galvanic current when its conductor is free to move. (See representation of it.) C and Z are two plates, one of copper the other of zinc, connected by a loop of copper wire an inch or two in diameter and suspended in a little glass vase, containing acidulated water, which by the aid of a piece of cork D, floats in a vessel of water. The loop of wire is the circuit conveying the electric current C to Z and—free to move—it must, if the magnetism of the earth is produced by electric currents circulating from East to West around it, arrange itself at right angles to the magnetic meridian, and so it does. The effect of this experiment was strikingly enhanced by Henry's method of suspending by a silk thread a large coil thirty inches in length bent into a parallelogram the ends of the wire projecting, and soldered each to a pair of galvanic plates. By placing a tumbler of acidulated water beneath the galvanic plates so that they could dip into it, he caused the coil to assume, after a few oscillations its equatorial position, transverse to the magnetic meridian. We give his own illustration and description of the arrangement.

"Fig. 3 represents a modification of De la Rive's ring on a large scale. A B, is a coil about nine inches by six, with a small cylinder of copper, enclosing another of zinc, without bottoms, soldered to its extremities, which end at C, the whole being suspended by a fibre of raw silk, so as to swing freely in a cup of acidulated water. When this apparatus is made sufficiently light it invariably places itself, after a few oscillations, at right angles to the magnetic meridian. W and E, are two pieces of card, with letters on them, to show which side of the coil will turn to the East or West; they may be properly placed by recollecting that the current from the copper to the zinc has a tendency to circulate in a direction contrary to that of the sun."

By a similar arrangement of two coils of different sizes, the one suspended within the other, Ampere's fine discovery of the mutual action of two electric currents upon each other was as strikingly displayed. See Henry's figure and description of it, as follows:

"Fig. 4 is designed to show the action of two conjunctive wires on each other: A B, is a thick multiplying coil, with galvanic plates attached, in the same manner as shown in Fig. 2; *c d*, is a lighter coil with a double cylinder, precisely similar to Fig. 3, and suspended within the other by a fibre of silk, passing through a glass tube *a*, the end of which is inserted into an opening *b*, in the upper side of A B; *e f* are two wires supporting the glass tube. When the cylinder *g* and the plates C are placed in vessels of acidulated water, the inner coil will immediately arrange itself so that the currents in both coils will circulate the same way; if the vessel be removed from C, and D placed in the fluid, the coil *c d* will turn half way round and again settle, with the currents flowing in the same direction."

"With many other instruments of a similar character, Henry made visible to his classes the newly discovered principles of electro-magnetism, and it is safe to say that in simplicity, distinctness and efficacy such apparatus for the lecture room was far superior to any of the kind then existing. Should anyone be disposed to conclude that this simple extension of Schweigger's multiple coil was unimportant and unmeritorious, the ready answer comes that talented and skillful electricians, laboring to attain the result, had for six years failed to make such an extension. Nor was the result by any means antecedently assured by Schweigger's success with the galvanometer. If Sturgeon's improvement of economizing the battery size and consumption by increasing the magnet factor (in those few cases where available) was well deserving of reward, surely Henry's improvement of a far greater economy by increasing the circuit factor (entirely neglected by Sturgeon) deserved a still higher applause." (Taylor Memorial of Joseph Henry, pp. 215–216.)

THE LIMITATIONS TO LONG DISTANCE TELEPHONY.—III.

BY

H. W. Dunbar

We have now reached the third stated cause of the limitation to telephony and arrived at that cause which the engineer has always considered the vital one, that is, the absolute amount of decay in the amplitude of the vibration, caused by the capacity of the line, and increasing rapidly with the distance from the origin.

Again examining equation (4) we see that the effect of the capacity is first to increase the absolute value of the current at or near the origin, and, second, to cause a logarithmic decrement of its value with an increase in distance from the origin. The self-induction of the circuit causes first a decrease in the absolute value of the current at or near the origin, and, second, decreases the rate of decay caused by the capacity. Thus these two factors work in opposition and some relation must exist between them which will render I a maximum at the distant end.

Taking the first differential coefficient of I with respect to L, equating to zero and solving for L, will give us a value of L which on examination will be found to render I a maximum for any given set of conditions; that is, a definite length of line with a definite resistance, capacity and number of alternations.

$$I = -\frac{2\,E\,\sqrt{C\alpha}\quad e^{\frac{pl}{2}}}{\sqrt[4]{R^2 + L^2\,\omega^2}\,(e^{pl}-1)} \text{ is a maximum when}$$

$$\frac{e^{\frac{pl}{2}}}{\sqrt[4]{R^2 + L^2\,\omega^2}\,(e^{pl}-1)} \text{ is a maximum.}$$

The term $(e^{pl}-1)$ becomes $(e^{pl}+1)$ when $l = \frac{1}{2}\,x_\lambda$, or an odd multiple of $\frac{1}{2}\,x_\lambda$ as previously stated. Therefore its mean value (e^{pl}) may be assumed with no error. (In all cases where the line is of considerable length the exponent pl becomes greater than unity and therefore the difference between $(e^{pl}-1)$ and $(e^{pl}+1)$ is slight.)

$$\frac{e^{\frac{pl}{2}}}{\sqrt[4]{R^2 + L^2\,\omega^2}\,(e^{pl})} \text{ is a maximum when } \sqrt[4]{R^2+L^2\,\omega^2}\,.\,e^{\frac{pl}{2}}$$

or $\frac{1}{4}\,log.\,(R^2 + L^2\,\omega^2) + \frac{pl}{2}$ is a minimum.

Differentiating with respect to L we have

$$\frac{L\,\omega^2}{2\,(R^2 + L^2\,\omega^2)} = \frac{l}{2}.\left(\frac{\omega\,p}{2\,\sqrt{R^2 + L^2\,\omega^2}}\right);$$

$$\text{or } \left\{ (R^2 + L^2\,\omega^2)^{\frac{1}{2}} - L\,\omega \right\}\,(R^2 + L^2\,\omega^2) = \frac{8\,L^2\,\omega^2}{C\,\omega\,l^2}.$$

The term $\left\{ (R^2 + L^2\,\omega^2) - L\,\omega \right\}$ has a maximum value of R and a minimum of 0 as L varies from 0 to infinity.

Designating it by R_o we have

$$R^2 = L^2\,\omega^2\left[\frac{8}{C\,\omega\,l^2\,R_o} - 1\right];$$

$$\text{or } L\,\omega = \frac{R}{\left[\frac{8}{C\,\omega\,l^2\,R_o} - 1\right]^{\frac{1}{2}}} \qquad (9).$$

This equation shows us that if $L\,\omega$ has a finite value the term $\frac{8}{C\,\omega\,l^2\,R_o}$ must exceed unity. Substituting the constants of the Chicago line we have

$$\frac{8}{C\,\omega\,l^2\,R_o} = \frac{8}{\frac{.017}{10^6} \times 1{,}000 \times 4 \times 10^6\,R_o} = \frac{2}{17\,R_o} \text{ at a fre-}$$

quency of 160 periods per second. Hence R_o cannot exceed $\frac{2}{17}$ or 0.118.

But $R_o = (\sqrt{R^2 + L^2\omega^2} - L\omega)$; hence $(R^2 + L^2\omega^2) < (L\omega + 0.118)^2$ or $L\omega > 20.4$. Hence L must exceed 0.0204 henrys per mile.

From the formula (9) we see that $L\omega$ varies from ∞ to 2.2 as R_o decreases in value from 0.118 to 0.059. Therefore the value $L\omega = 20.4$ is accurate enough for all purposes. A single approximation, however, determines its value far closer than 1 per cent. at 20.5. Therefore we see that for this particular rate of alternation the current at the distant end could be increased by an increase in the retardation factor. The abruptness of the curve at its maximum point may be shown by a simple calculation for this frequency, *i. e.*, 160 periods per second.

Value of L in henrys.	Current in amperes (maximum) at the distant end.
.010	$-2E \times .000307$
.020	$-2E \times .000323$
.040	$-2E \times .000314$

Thus the apex of the curve is extremely blunt and the value of the retardation factor may vary throughout a wide range with but little effect upon the resulting current at the distant end even at this low frequency.

An approximation of equation (9) may be written thus:

$R_o = \frac{8}{C\omega l^2}$; but $R_o = \sqrt{R^2 + L^2\omega^2} - L\omega$; hence

$$L\omega = \frac{C\omega l^2 R^2}{16} - \frac{4}{C\omega l^2}. \qquad (10).$$

Where $\frac{C\omega l^2}{16}$ is greater than 2 or 3, little error is introduced by neglecting $\frac{4}{C\omega l^2}$, and we may finally write the approximation

$$L = \frac{C l^2 R^2}{16}. \qquad (11).$$

We see from this that upon such a line as that under discussion, the retardation factor varies directly with the capacity per unit of length, with the square of the resistance per unit of length, and with the square of the length of the circuit. The interesting fact is that it is independent of the rate of alternation. Up to a certain point the factor L is influenced by the rate, increasing with an increase in the frequency as seen by equation (10). But when the rate approaches 100 or more alternations per second upon a line of this length its influence upon the value of L for a maximum I disappears. As all important telephonic rates exceed 100 vibrations per second, the value of L which renders 160 periods per second a maximum will render them all a maximum.

An interesting point is the determination of the length of line upon which the maximum current is naturally reached; that is the length corresponding to a value of L of .00161 henry per mile.

Substituting in (11) we have,

$$l^2 = \frac{16 \times .00161 \times 10^6}{.017 \times 4.84} = 320{,}000.$$

Therefore, $l = 570$ miles, or a distance of 285 miles. Thus with the line construction assumed, no gain in volume could be obtained by an increase in the retardation upon circuits extending to a distance less than 285 miles.

Before proceeding further it would be pertinent to inquire if there exists a finite value of C which would tend to produce a maximum value of the current at the distant end.

$I = -\frac{2E\sqrt{C\omega}}{\sqrt[4]{R^2 + L^2\omega^2}} \; \frac{e^{\frac{pl}{2}}}{e^{pl} - 1}$, which is a maximum when $\sqrt{C\omega}\,\frac{e^{\frac{pl}{2}}}{e^{pl} - 1}$ is a maximum. Remembering that the fraction $\frac{e^{\frac{pl}{2}}}{e^{pl} - 1}$ may be represented by $\frac{1}{e^{\frac{pl}{2}}}$ we will discuss $\frac{\sqrt{C\omega}}{e^{\frac{pl}{2}}}$ for a maximum, or $\left(\frac{1}{2} \log C\omega - \frac{pl}{2}\right)$ for a maximum.

Differentiating and equating to zero, we have

$$\frac{1}{2C} = \frac{l}{2} R_o^{\frac{1}{2}} \frac{\omega}{4\sqrt{\frac{C\omega}{2}}}; \text{ or } C = \frac{8}{l^2 R_o \omega} \qquad (12).$$

Where R_o as before, represents $\sqrt{R^2 + L^2\omega^2} - L\omega$.

Thus we see that under certain conditions the value of the current at the distant end of the line is actually increased by the capacity of the circuit. The value of C to give a maximum current at the distant end varies inversely with the square of the length of circuit and as some power of L and ω determined by the resistance in the factor $(\sqrt{R^2 + L^2\omega^2} - L\omega)$. As an increase in L decreases R_o, C varies directly with some power of L.

It must be borne in mind that this and the other formulæ apply only to cases in which the wave length is not greater than twice the length of the circuit. Thus from equation (12) it would appear possible to secure a greater current at the distant end of a line devoid of all retardation if it contained a small amount of capacity rather than no capacity at all. For when $L = 0$, $R_o = R$ and $C = \frac{8}{l^2 R\omega} = \frac{.0009}{10^6}$. But on substituting these values in (7) we find $x_\lambda = 6{,}800$ miles which is more than twice the circuit length. As C varies inversely with the square of the length and inversely with ω in formula (12) when $L = 0$, and as the wave length varies inversely as the square root of C and ω when $L = 0$, we see that no values of l and ω can render (12) applicable when $L = 0$. This can only mean that when $L = 0$, C must be zero to render I a maximum.

Substituting the constants of the Chicago line in (12) we find that if C had a value of $\frac{8}{4 \times 10^6 \times 1.1 \times 10^3} = \frac{.0018}{10^6}$ instead of $\frac{.017}{10^6}$ it would increase the current at the distant end and render it a maximum for this value of L.

SALADIN'S ELECTRIC FURNACE.

A PAPER has been read by Mons. Saladin, before the Chemical Society of Paris, on his improved electrical furnace. This furnace appears to differ in principle from others, as it is based upon the electrical cautery. A platinum spiral rendered incandescent by means of a continuous or alternating current of electricity is placed in a vessel of refractory material, and the whole is enclosed in a cast-steel case. It is possible to act upon substances placed in this furnace by means of high pressure, as well as high temperature. A side opening in the case communicates with a pump and manometer, and admits of the pressure being increased to 1,000 atmospheres. The range of temperature available is 1,500°–1,800° C., and this is measured by a platinum-rhodium couple, arranged according to Le Chatelier. Mons. Saladin claims that by means of this furnace it becomes possible to fuse metals under high pressure, and while maintaining any desired pressure to cool the molten metal as slowly as is deemed desirable, this cooling being governed by regulating the current. At present we understand that this furnace is being used in obtaining experimentally the reproduction of minerals from elementary matters, the idea being to imitate the probable conditions under which they have been naturally formed.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies, - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

VOL. XVII. NEW YORK, JANUARY 10, 1894. NO. 297.

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THE WESTINGHOUSE COMPANY AND THE NIAGARA CONTRACT.

WE print elsewhere in this issue an important communication from Mr. L. B. Stillwell, on behalf of the Westinghouse Co., which sheds a strong side light on the information embodied in Prof. Forbes' paper on the electrical features of the Niagara transmission plant. This communication, taken in connection with Prof. Forbes' own statements, would make it appear that so far as essential features are concerned, the promoters of the Niagara scheme deemed it wise to accept the advice of experienced constructors in preference to that of their consulting electrical engineer. And this brings us back to the old question of the relation between these two frequently antagonistic elements. The consulting electrical engineer's services have from the very outset been little availed of in this country, purchasers of electrical plants having in the large majority of cases left matters entirely in the hands of the contracting companies, which practice has, it must be admitted, given rise to but few conflicts. In the case of the work at Niagara, it would appear that the consulting electrical engineer, instead of confining himself to laying down the conditions and leaving to the contractors to devise the best methods of carrying out the specifications, actually entered into competition with them, with the result that might have been foreseen. According to Mr. Stillwell it would also seem that while the engineers of the Westinghouse Co., are in accord with Prof. Forbes on the selection of the methods adopted, they differ from him radically in the assumptions and reasoning which led them to advocate the final plans adopted.

It would be interesting to know the details of these differences and it is to be hoped that the electrical profession will not be kept in ignorance of them. For this reason it is perhaps a pity that Prof. Forbes' paper could not have been read and discussed on this side of the water also. Probably an early opportunity may be afforded by the Institute for such a timely discussion.

THE TESLA ELECTRICAL OSCILLATOR.

WHILE Mr. Tesla has until the last year or two confined himself to purely electrical work, his most recent labors have been devoted to the solution of a mechanical problem intimately connected with the generation of electric currents, the outcome being his electrical oscillators, of which we describe two additional types in this week's issue. Aside from the numerous possibilities in other fields it would seem that if the "oscillator" fulfills the expectations of its inventor, it is destined to create little short of a revolution in our present methods of power generation and distribution. It must be confessed that in spite of the numerous obvious cases in which the application of motors to the driving of machines and line shafting would prove a gain over the present methods, and despite even the successful working of such plants, the conservative factory owner and machinist still looks with a doubtful glance at these innovations of the last ten years. But, if, as Mr. Tesla claims, he will be able to furnish electric current by means of his oscillator, at anything like one half the cost for fuel now required and with much simpler apparatus, the aspect becomes quite a different one. Such an accomplishment would immediately appeal to every power user and would at once determine the direction of future methods of local power transmission. Indeed it might not be inapt to inquire here also into the probable effect of such an achievement on long distance electrical transmission. With the potentials which have been practically handled up to date, the size of conductors required has not permitted of the extension of power transmission plants utilizing water power, to the distances hoped for, although we note small but constant gains in this respect. With the initial source of energy in the shape of fuel reduced to one half the present cost, it would indeed require an exceptional set of conditions such for example, as those existing at Niagara or in regions far remote from fuel supply to make the utilization of water-powers worth considering for any considerable distance from the fall. Already the cost of water power even locally distributed has in numerous conspicuous instances proved less economical in competition with modern steam engines and a still further improvement in the latter added to the benefits to be derived from electric motors must still further tend to decrease the comparative margin of economy with water power. It seems strange indeed that a power available on the spot should not be able to compete in economy with another form of energy hauled frequently for a distance of hundreds of miles, but experience bears out the conclusions just stated. While the above remarks refer merely to power distribution they are equally applicable to the question of electric lighting and current distribution in general. From Mr. Tesla's observations before the recent meeting of the New York Electrical Society (see THE ELECTRICAL ENGINEER, Dec. 6 and 13, 1893) we infer that he has so far gone into the study of the methods he advocates that we shall not have to wait long for their practical realization.

ELECTRICITY AND THE STATE.

The reference to electricity in no less than three of the annual State papers of New York serves to indicate the important position assumed by this later source of energy. In the reports made to the Legislature by Gov. Flower, State Engineer Schenck and Superintendent of Public Works Hannan, reference is made to the contemplated employment of electricity as a motive power on the Erie Canal. The utterances of Mr. Schenck show him to be still somewhat skeptical as to the economy of the electric method as compared with the steam canal boat, the independence of which still appears to him as a most valuable feature. Judging from his other remarks it is evident that he has never heard of the dynamotor or motor transformer, nor of the work now actually being done by alternate current motors. On the other hand we are glad to note the intelligent grasp of the subject apparent in the brief reference to it contained in Mr. Hannan's report. This gentleman estimates that with a steam electric plant serving a stretch of 50 miles and operating 210 days in the year canal boats can be propelled for 10 cents per mile per boat, while still others estimate it at nearly one half this figure. If during the season when the canal is closed the power could be utilized in other ways the cost would be still further reduced. Mr. Hannan concludes from all this that the claims to consideration for electric motive power on the canal are extremely well founded.

In the message of Governor Flower we note also a reference to the alleged increase of fires due to defective electric wiring, and a suggestion that persons installing such work be licensed by a competent board certifying to their fitness to carry it out properly. There is much to be commended in this plan which was for some time in operation in New England, but has unfortunately been allowed to lapse. Perhaps the trades unions themselves might find the easiest solution of this problem by allowing no one into their ranks who could not pass a rigid examination on wiring work. The statement that in the city of New York there are four times the number of fires that there are in the principal cities of Europe, accompanied by four times the destruction of property, may be true, but to cite it in the present connection without further qualification and without giving any figures or details whatever seems hardly fair. We know as a matter of fact that the actual figures on fires claimed to be of electrical origin do not in the least warrant any such assertion or inference and we are sorry indeed to see so unguarded a statement in a Governor's annual message. Last week we referred to a case within our personal knowledge where the insurance rate had been advanced nearly five fold—from 15 cents per $100 to 70. Inquiry elicits the fact that apartment buildings over a certain height have been re-rated on that basis. As we said last week, electricity has nothing to do with the case.

BI-METALLIC WIRES IN TELEPHONY.

EVER and anon the electrical public is brought face to face with statements and facts so at variance with past experience that they force themselves upon its attention and cause it to pause and ponder. The most recent example of a surprise of this nature is the discovery of the extraordinary properties of a composite wire for the transmission of telephonic currents and indeed for alternating currents in general. If we are to believe the statements printed on another page, from Mr. Wm. H. Eckert, whose long telegraphic and telephonic experience entitles his opinion to some weight, a composite wire embodies within itself properties which serve to overcome retardation whether due to electro-magnetic impedance or electro-static charge while at the same time it makes current largely independent of insulation. A result differing so widely from what we have been accustomed to deem as an inevitable accompaniments of all conductors will of course be accepted with great caution, but as the inventor bases his statements on actual experiments we must await further developments on this decidely interesting innovation with no small hopefulness.

An Injunction Against a "Gas" Lamp.

As we go to press, news reaches us by telegraph that Judge Shipman has to-day (Saturday) granted an injunction against the "Novak" incandescent lamp. The proceedings at Hartford were recently reported in our columns. As we are still without the text of the decision, we are unable to pronounce on its scope. The lamp, it will be remembered, has a bromine atmosphere in the chamber. This was held by the defendants to exclude it from the scope of the Edison patent.

BI-METALLIC WIRES FOR TELEPHONE CONDUCTORS.

OUR readers may recall the fact that early in 1883, the Postal Telegraph Co. in extending its lines to the West employed a composite wire consisting of a steel core upon which a thick layer of copper was deposited. This conductor had a tensile strength greatly exceeding that of any similar line theretofore employed, and, in addition, had a much greater conductivity, its resistance between Chicago and New York being only 1,552 ohms, or a little over 1½ ohms per mile. The results obtained with this wire telegraphically were so good that it at once suggested the possibility of employing the line for telephonic transmission as well, and among those who tried experiments on it were Van Rysselberghe, Baxter and others. Although only a single circuit grounded at both ends was employed, the articulation was distinct with all kinds of transmitters, and between New York and Cleveland the ordinary Bell magneto receiver used as a transmitter was sufficient to carry on conversation. These good results were attributed generally to the high conductivity and excellent insulation of the wire, and subsequent long distance telephone work was carried out on the basis of securing similar advantageous conditions.

Among those who had an opportunity of witnessing these experiments was Mr. Wm. H. Eckert, at that time general manager of the Metropolitan Telegraph and Telephone Co., of New York. When the Long Distance lines between New York and Philadelphia were erected, the difficulty at first experienced in obtaining distinct articulation, before the proper transposition of the wires was effected, impressed itself strongly upon Mr. Eckert, in whose mind the experiments with the Postal Telegraph wire were still fresh. After much thought devoted to the subject Mr. Eckert arrived at the conclusion that neither the greater conductivity nor the higher insulation of the Postal wire accounted for the excellent results obtained with it but that its properties were due to the dual nature of its composition. Subsequent experiments appear to have fully convinced him of the correctness of this view, and in a patent just issued to him we find a number of most interesting statements relating to his discovery.

Mr. Eckert holds that telephonic transmission, or rapidly alternating currents in general, may be more perfectly effected upon a bimetallic conductor, such as steel and copper in equal parts, than upon a conductor of one material such as copper; and with the advantage that such transmission may be effected upon a circuit consisting of a single composite wire and an earth return as perfectly as though two copper wires, each of equal conductivity, were arranged in a closed metallic circuit. In other words, he finds that a single bimetallic conductor joining two distant points is a more perfect medium for telephonic transmission and for conveying generally rapidly alternating currents than are two copper conductors, each of a resistance equal to that of the bimetallic wire; and that from this fact the two conductors necessary to form a single metallic circuit may be replaced by a single wire costing little, if any, more than one-half of a copper metallic circuit. He also claims that less insulation is needed to protect a bimetallic wire than is necessary for copper or other single substance conductors, in the transmission of rapidly alternating currents, and that from this fact not only the expense of constructing cables, whether ærial, underground or submarine, may be greatly reduced but more wires may be placed within a cable than could be done if the usual thickness of insulation were used. Moreover, for the transmission of alternating currents, wires of smaller conductivity according to the ordinary resistance measurements, may be used than is possible if they were constructed of copper, iron or other single metal.

Among the experiments made by Mr. Eckert to demonstrate the practical nature of his discovery is one in which a composite bare wire of No. 20 B. & S. gauge was stretched on the ground for a distance of 10 miles and grounded at both ends. The articulation left nothing to be desired.

Mr. Eckert does not vouchsafe any theory to account for the remarkable properties which he attributes to the composite wire, but contents himself thus far with the statement of the facts as he has found them to exist.

ELECTRIC TRANSPORTATION DEPARTMENT.

GOVERNOR FLOWER ON ELECTRICAL CANAL PROPULSION.

IN his annual message to the New York State Legislature, Governor Flower makes the following reference to the use of electricity on the Erie Canal as one of the means of deriving more benefit from that great waterway:

"The most practical suggestions are contained in plans for increasing the tonnage of the Erie Canal. One of these plans has been in process of construction during the last seven years. It consists in lengthening the locks so as to permit two boats to pass through at the same time, thereby saving expense and time of transportation. Under this policy all but four of the locks which it is feasible to lengthen, in the opinion of the Superintendent of Public Works, have been so lengthenened. The cost has been about $3,000,000 thus far. The results have been disappointing, for the tonnage of the canals has diminished instead of increased. The lengthening of the remaining four locks will not change the situation materially, for it requires on the average about three minutes to lock a boat, so that the time saved between Buffalo and Albany by lengthening the remaining locks would be less than half an hour.

"Another plan proposed in connection with the lengthening of the locks is the deepening of the canal and the raising of its banks, so as to enable boats of larger capacity to be used. The deepening of the canal would necessitate the rebuilding of all its structures —an enormously expensive undertaking; the raising of the banks, however, would be quite feasible as a means of securing greater depth of water. Something in this direction should undoubtely be done when the present capacity of the canal proves insufficient, and at present provision should be made for the prompt removal of all accumulations in the bottom of the canal, so that its full depth may be enjoyed.

"It has seemed to me, however, that the most practical plan for immediately increasing the tonnage of the Erie Canal is that which would supply a speedier and more economical motive power. Mules and horses now propel canal-boats at a rate of about two miles an hour, while steam sends them along at the rate of about three miles. The banks of the canal will stand a speed of about four miles an hour. It seems to me, after personal observation of present methods, that electricity might be applied as a motive power with a considerable saving in cost and a considerable increase in speed. Experiments in this direction were authorized by the last Legislature upon my recommendation, and seem to have demonstrated clearly the feasibility of using electricity as a motive power on the canals, The only question still to be determined is that of cost, and the estimates are quite favorable to a considerable reduction from the cost of propulsion by steam. Just how much of a reduction could be obtained it is of course impossible to say definitely, but very conservative estimates make the saving in cost of transportation at least 25 per cent., and the increase in speed at least 30 per cent. The advantage of electricity over mule or horse power would be much greater. If these results could be attained the benefit to the canal would be immediately greater than the benefit which would flow from all the proposed enlargements, and need not cost the state a penny. Boatmen could make many more trips in a season, fewer employés would be needed on each boat, no money would be required for horses and mules, the large space occupied by steam-boiler and engine would be saved for freight, and danger from fire or explosion would be avoided. At the same time the increased tonnage and business of the canal would provide more employment and more remunerative occupation for boatmen. Other advantages readily suggest themselves. It should be clearly understood, moreover, that the adoption of electricity as a motive power does not mean the abandonment of horse, mule, or steam power if boat-owners prefer to have their boats propelled by these powers. The idea is that whether the state furnishes the electric power from its own plant, or whether individuals or corporations furnish it under contract, there will be no compulsion to use it, but the endeavor will be to supply it at such a low cost to boatmen that they will find it advantageous to apply it to their boats in the interest of economy.

"This plan need not interfere, either, with any proper enlargement or deepening of the canal. Instead, if the plan is found to operate satisfactorily, the next logical and necessary step would probably be to so improve the canal as to enable the use of larger boats. But for the present I am quite convinced that the proper course is to give electric propulsion a fair trial, and if it accomplishes what is claimed for it, a new era of activity and prosperity should begin for our canals. Grain has been carried during the last season from Chicago to Buffalo for as low as one cent a bushel; boatmen can carry it profitably at two cents a bushel. If by cheaper and quicker propulsion the cost from Buffalo to New York by way of the Erie Canal can be reduced to three cents a bushel, as is reasonable to suppose, there is no other carrying route that can successfully compete with it, and a continuance of New York's supremacy is assured. Moreover, the harnessing of the tremendous water torrent of Niagara to the wheels of industry will furnish the cities of Buffalo and Rochester and all western New York with the cheapest power for manufacturing in the United States. We may look forward to the time when the great flour mills of the world will be located there, for the cheapness of power would more than compensate for the cost of transportation of grain from the fields of the Northwest. So with other manufactories. Then, more than ever, will be needed cheap transportation through the State. To-day the Erie Canal does not carry one-half its capacity. Reduce the cost of transportation and increase the speed and the tonnage will increase, and when the tonnage increases then will be the proper time to seriously consider expensive schemes of enlargement.

"The essential point in arranging for the application of electric propulsion on the canals is that the power should be furnished at the lowest possible cost, and any construction of state works for this purpose or any contract with individuals or corporations for supplying power to the boatmen should be hedged about with abundant safeguards for the protection of the public interests."

THE NEW YORK STATE ENGINEER ON CANAL TROLLEYS.

STATE ENGINEER SCHENCK, in his annual report to the New York State Legislature has a very interesting discussion of the application of electricity to the canals of the State. It is as follows:

Of the several schemes of improvement advocated by the friends of the Erie Canal, one of the most feasible, when its comparatively small cost is taken into consideration, is that known as the Seymour plan, by which it is proposed to deepen the canal to a depth of nine feet of water, by raising the banks one foot and by excavating the bottom one foot, except through locks and over aqueducts and culverts, and lengthening the locks so as to permit the passage of double headers.

I have plans for an enlarged canal, 100 feet in width and 12 feet deep, capable of bearing barges 250 feet in length and 25 feet broad on beam, with 10 feet draught of water, and of the lowest possible height above water, so that the greater part of the bridges crossing it could be fixed structures, instead of movable ones. The cost should not exceed $25,000,000.

I recommend that a commission be appointed, whose duty it shall be to examine into this matter and to report its conclusions to the Legislature at the earliest time practicable.

While there are some minor difficulties to be overcome in the application of the trolley system to canal navigation, such as the holding of the boat while not in motion or moving at a low rate of speed and exposed to the action of high winds, in proper position to secure easy contact of the trolley with the wire carrying the current, the devising of means by which boats traveling in the same direction at different rates can pass each other, or by which boats can be brought up to or taken away from a dock, etc., I think none of these difficulties are so serious but that they will be surmounted by the inventive genius of our people. The main question is a purely economic one, and the success or failure of investigations now in progress will be decided by the answer to the question, Can the electric power be furnished to each propeller at less cost than that of steam?

Two trolley methods have been suggested by which to reach the desired end—one by establishing power houses along the line of the canal at such distances apart as may be found economical or desirable, and in these power houses, by the use of fuel to to generate steam, transform this steam power into electric power, transmit this electric power by wire between these power houses, and by means of a trolley wire communicate it to motors in canal boats acting to turn a screw wheel. The other is the generating of electricity in large quantities by means of water power at some point or points where nature has provided the means, and then transmitting the current over long distances by wire.

From the figures furnished by the Albany Electric Railway, I conclude that if, as was shown me, we succeeded in developing in an engine cylinder one horse power per hour with two pounds of coal, we would have a consumption of coal to obtain one horse power per hour applied at a distance of eight miles from power house of from four and a half to four and three-quarters pounds. This is in excess of the amount of the coal consumed by canal steamers, to say nothing of difference in first cost of plant required.

The method of generating electricity in large quantities at points where large water powers exist and thence transmitting it by wire over long distances is the one which, to my mind, contains the greatest promise of success. In order, however, to economically transmit the large quantities required, the current in the feed wire must pass at very high voltage, and in order to secure safety that in the trolley wire must pass at a low voltage. While it is perfectly feasible to transform an alternating current from a high to a low and from a low to a high voltage, unfortunately no means have yet been found for thus dealing with a continuous current, and it is the continuous current alone that has as yet been successfully applied to the operation of motors.

Upon the solution of one or the other of these difficulties, and upon the devising of means to more economically and perfectly insulate the feed wires, depends, in my opinion, the success or failure of the efforts now being made in this direction.

I am advised that there has been developed by a corporation operating at Niagara Falls a water power yielding on the American side 200,000 horse power per hour (*sic*), and on the Canadian side 120,000 horse power per hour, which, they state, could be disposed of at a profit to the corporation at the price of $4 horse power per annum, measured on wires at Niagara Falls, if sold in its entirety. In considering this question it must be remembered that the steamboat has and must continue to hold an advantage over a trolley-propelled electrical boat in that she is independent of outside aid in navigating the Hudson River.

I commend this subject to your careful consideration and hope that you will adopt the necessary legislation to secure the continuance of the investigations and experiments necessary to reach a conclusion.

FROM NEW YORK TO PHILADELPHIA BY ELECTRIC RAILWAY.

WHAT will be, when completed, the longest electric railway in existence is about to be built between New York and Philadelphia by way of Newark, Paterson and Trenton. The originator of the enterprise is Mr. Joseph H. Reall, of Bloomfield, N. J., who is well known as a railway builder, and the New Jersey Railway Company has been formed to carry out his plan.

There is already an electric railway projected along the banks of the Delaware from Philadelphia to Trenton. Beginning where this ceases, Mr. Reall's system leaves the latter town and passes through Lawrenceville, Princeton, Kingston, Rocky Hill and East Millstone to Bound Brook, whence branches lead to Somerville and Raritan on the west and New Brunswick on the east. Passing north from Bound Brook the line runs northeast to Westfield, passing through Dunellen, Plainfield and Fanwood. From Westfield a branch will run to Rahway, Elizabeth, Woodbridge, Boynton Beach and Perth Amboy, forming a short line from North Jersey and Eastern Pennsylvania to the seashore.

The line continues northeast from Westfield passing through Springfield, Millburn, Wyoming, South Orange, Orange, West Orange, East Orange, Bloomfield, Montclair, and thence to Paterson, with a branch from Millburn to Irvington and Newark on the east and to Morristown on the west. Another branch extends from Montclair to Caldwell. Altogether, the system comprises more than one hundred miles of track. From Newark to Jersey City there is now a well equipped electric road in actual operation.

The entire line has been surveyed, the right of way has been secured and the necessary franchises are assured. The people from one end of the line to the other are highly in favor of its construction, and the leading and most influential men in the different towns and the intermediate country through which the road passes are actively interested in and warm supporters of the enterprise. The road will be laid with seventy and ninety pound steel rails and equipped with thirty-four foot, double motor cars of thirty horse power each. The speed will be eight to ten miles per hour in cities and towns, and twenty-five to thirty miles in the country. The cars will be run on from fifteen minutes to one hour headway, according to the amount of traffic, and where the trade demands it, five minutes headway. Five power plants of 1,000 horse power each, located at Trenton, Rocky Hill, Bound Brook, Westfield and Orange will supply the power.

The road will connect with the principal steam roads of the State. It will intersect both the Pennsylvania and Reading at Trenton, the Pennsylvania at New Brunswick, the Lehigh Valley, Reading and New Jersey Central at Bound Brook, the New Jersey Central at Plainfied and Westfield, the Morris & Essex at Millburn, South Orange, Orange and Montclair, the Delaware, Lackawanna & Western at Paterson, the New York & Greenwood Lake at Orange and Montclair, the Erie and the Susquehanna & Western at Paterson.

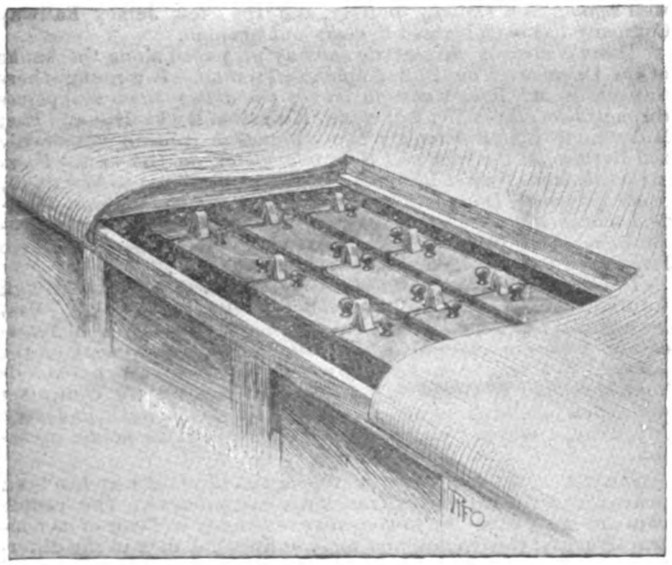
The New Jersey Improvement Company has been incorporated to build and equip the north end of the road ready for operation and work will be commenced early in the spring. Its officers are: J. L. Stadelman, president; E. W. Hine, vice-president; Charles E. W. Smith, treasurer; John U. Bethell, secretary. Another construction company will probably be organized by Mr. Reall to build the southern end and the branch lines.

STORAGE BATTERY TRACTION AT BEREA, OHIO.

The beautiful little town of Berea is located west of Cleveland, O., with which it is connected, besides the railroads, by the Cleveland and Berea Street Railway. This road is ten miles long, and runs through a fertile farming country its entire length, for it connects at the Cleveland end with the terminus of the Woodland Avenue and West Side Street Railway. Starting from the Cleveland end the car has to mount one 4 per cent. grade 600 feet long; then after half a mile stretch of nearly level road comes a grade a little over 5 per cent. about 800 feet long. These two grades are the only large ones on the line but the road is made up of smaller ones as it is in no place level. The track is laid on one side of the country road and follows the ups and downs of the land, as very little grading has been done. The road crosses the L. S. & M. S. R. R. twice and runs under the C. C. C. & St. L. R. R. by a tunnel.

The road is operated by the storage battery system of the Ford-Washburn Storelectro Co., of Cleveland, Ohio. At present there is but one car on the road and this is equipped with only one set of storage batteries; yet this car has been making three round trips, or sixty miles, every day since October 2, and in the first 31 days carried 4,753 passengers and covered about 2,000 miles. Part of the time an open trail car has been attached to the battery car and on Sunday, October 22 the two cars carried 460 passengers on the three round trips; 142 passengers at one time, one way, on the two cars.

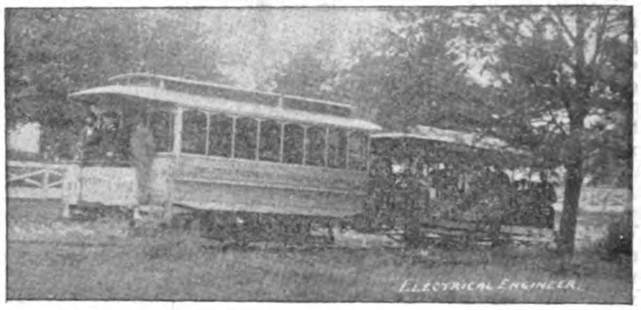
On November 19, the motor car without the trailer brought 78 passengers from Berea to Cleveland. In drawing the trailer and carrying 142 passengers up the 5 per cent. grade the ampere meter registered 130 amperes. A large permanent power house will be erected at the Berea end, which will be equipped with modern machinery for handling and charging the cars and batteries. At present there is a temporary power house, with a 10 h. p. threshing engine and boiler, belted direct to a 16 ampere 500 volt Ford-Washburn generator. The car has only one set of batteries at present, and the cells are charged before each round trip which takes about two hours.



Ford-Washburn Cells Under the Car Seat.

The car is 28 feet long over all and 21 feet inside measure, and was built by the J. G. Brill Co., of Philadelphia, especially for this road. It is painted white with gold trimmings, has plate glass windows, fancy hard wood interior finish and is handsomely upholstered. The batteries are placed under the seats, in three rows of 28 cells each, on either side, making 168 cells in all. The car body is mounted on a Tripp truck with extension springs having a wheel base of 7 feet with 33-inch wheels. The car is propelled by one 35 h. p, series wound Ford-Washburn street car motor weighing 2,000 lbs.

The Ford-Washburn Storelectro Co. have two means of varying the speed of their cars, the first dependent on the manner of coupling the batteries by which three speeds are obtained, *i. e.*, with four sets of 42 cells each in multiple, giving 84 volts, with two sets of 84 cells in multiple giving 168 volts, or with the entire 168 cells in series giving 336 volts; the second consists in commutating the fields by which four changes in speed can be obtained.



The Ford-Washburn Storage Car on the Cleveland and Berea Road.

A special switch for instantaneously shutting off the current is placed at each end of the car to be used in cases of emergency. The car is further equipped with ratchet brakes and all latest improvements.

The road has been in operation since October 2. It has carried over 7,000 passengers, and has plowed its way from Berea to Cleveland through snow which at places was more than two feet deep.

MISCELLANEOUS.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—IV.

(*Concluded.*)

BY PROF. GEORGE FORBES.

GENERAL DESCRIPTION OF A 5,000 H. P. ALTERNATOR.

On the bed-plate a vertical cylinder is bolted, with projections to support the fixed armature and the bearings of the revolving part. The armature coils are wound independently and can be removed and changed. They are fixed in slots in the fixed armature. They are encased in an oil-tight casing through which oil can be circulated. The field magnet is external to the armature, and has the poles pointing radially inwards. It consists preferably of forged steel supported by a spider with eight arms, which may be of steel with a covering of thin sheet metal, on which cups are provided for forcing air into the interior of the machine. The pole-pieces are bolted on to the steel rim. The field coils are of copper strip, two coils being wound upon each pole, with a space between them for air circulation. The exciting current is applied by rings of tempered copper on the spider, having fixed brushes rubbing on them. The hub of the spider is firmly fixed to the upper end of the shaft. The spider supports the heavy rim by 16 studs and nuts. The shaft is supported by two bearings, each of which has four radial arms, which are bolted to four corresponding projections on the cast-iron cylinder. This cast-iron cylinder is bolted to the bed-plate, and adjusted thereon by wedges. Besides having on it the projections for carrying the bearings on its inner side, it has on its outer periphery a series of vertical ribs against which the stampings, or sheets of iron forming the armature, rest. It also supports the lower end plate on which the armature is built up, and the armature is keyed to it, by a single key. The armature is wound drum fashion—that is, all on the outside. This enables the coils to be wound independently and laid in their place, and also to be easily replaced in case of accident. In order to do this satisfactorily, the slots for each coil in the iron are cut, not radially, but parallel to each other. Each coil is encased in insulating material, which forms a tube through which oil may flow as in a transformer, but may be forced, in which case its circulation is maintained by a pump. Round the base of the machine there are two oil pipes, one being the inlet the other the outlet. The inlet pipe is connected with a reservoir of oil in the power-house. The outlet pipe leads by another pipe to cooling arrangements in running water, from which the oil is pumped to the reservoir. From the inlet pipe 16 brass tubes are led to the junction boxes at the bottom of the 16 coils; the 16 other brass tubes are led from the junction boxes at the top of the coils through the interior of the fixed armature and bent over the foundation plate, and so connected to the outlet pipe which surrounds the bed-plate. The bed-plate is a single iron casting, and in order to enable it to be transported over the railways it was necessary to limit its diameter, as shown in a supplementary drawing, which shows the improved oiling arrangements, which were worked out by my chief draughtsman at Niagara Falls, Mr. Baumann. The armature is built up of thin sheet iron, with ventilating spaces as shown on the drawing. The bolts which hold the armature together are eight in number, to be made of nickel-steel, a metal which has the great advantage of being non-magnetic, and of very high electrical resistance and great mechanical strength. The amount of nickel is 25 per cent.

There are 16 armature coils, eight being of one kind, called "short" coils, and eight of another kind, called "long" coils, the length of wire on each coil being the same. The short coils are bent over at the end plate, and the long coils are wound in one plane, and enclose the short coils. I find that if we are to have a very stiff field, with first-class quality of iron in the fields, each coil would consist of 72 turns of pure copper wire, No. 0 of the Brown & Sharpe gauge, which gives a very low density of current, and reduces the heating. In fact, it has been my view that in designing the machines for so great and permanent a work every effort should be made to reduce the rise in temperature, even to far below what has ever been done in the past. The unequal expansions and contractions of materials in a machine of this kind are very injurious to its permanence, and affect the insulating material seriously. The layers of wire in the coils are separated by mica. Each coil when wound has strips of insulating material laid spirally round it, so that oil may circulate freely in the intervals, and the whole is enclosed in a casing of strong insulating material. The material which I prefer for this purpose is certainly woodite, an eighth of an inch of which will not break down with 30,000 volts, and which is not acted upon by oil even at high temperatures. I have a record of tests with oil which are conclusive on this point. It is quite the best material I have seen for the purpose, though costly, and, being a secret process, it may be difficult to ensure uniformity.

The frames of the bearings are of cast iron, with four radial arms, which rest upon four projections cast on the vertical cylinder, and are bolted to them. By this means, when the field magnets with the shaft have been lifted out of place, the bearings can be twisted through an angle of 45 degrees in a horizontal plane and then raised out of place, leaving a space of five feet in diameter through which portions of the turbine shaft can be raised for repair. The bearings are oiled at the centre by oil forced under pressure through a pipe. The oil is then distributed over the bearings by spiral grooves. A spiral groove is also cut in the hub of the frame, with a pipe at each end to admit of water circulation to cool the bushing. At two opposite sides of each bearing the bushing is made thin, and a rod of bismuth is soldered thereto; so that if the bushing is heated, a thermo-electric current shall be created which, by means of a relay, can ring a bell in the power-house. When this occurs, water can be immediately admitted to cool the bearings, and the attention of the workmen drawn to the necessity of an examination.

One of the parts which required most consideration was the material of which the spider supporting the field magnets should be constructed. The best plan is to make it of steel, for the sake of lightness, and to cover it with a copper covering, which might, I think be spun; or, perhaps better, electro-deposited nickel might be used.

Between the pole-pieces the space is filled up with a screen or plate of metal so as to direct the air ventilation only upon the parts which most require cooling.

It will be obvious from this design, considering that the speed of revolution is 250 per minute, that great care has to be devoted to the balancing of the revolving parts; everything has to be calculated not only for a speed of 250 revolutions, but for double that amount, which is the maximum speed at which the turbines could possibly run—at which speed they might run through a break down of the governor, although this is an accident almost impossible to occur. Each of the revolving parts will of course be balanced individually, and I have suggested a plan for the final balancing which seems likely to be effective. A temporary bushing would be put in the bearings, of india-rubber lined by a thin metal tube. The dynamo would then be rotated slowly and the balance adjusted in the usual way. The speed of revolution would be gradually increased—a new adjustment being made at each speed—until a speed of 500 revolutions a minute is attained, and when an adjustment has been made at this speed it is pretty sure that the balance at 250 revolutions per minute will be very perfect, and the mechanical friction reduced to a minimum.

As stated before, the oiling arrangements have been introduced not only to ensure higher insulation and to preserve the insulating material, but also to lower the temperature as much as possible, because every step we take in the reduction of temperature is an advance. These oiling arrangements may perhaps be adopted in the future, but at present we are not making use of them in the machines which are in process of construction. When we have had experience with these we may in future adopt the oiling arrangements; and as there is likely to be a great development in the direction of electric transmission of power in connection with the utilization of water power in many parts of the world, it has seemed well to me to put before you these details, so that they may be considered in other cases that may arise.

At a meeting of the Board of Directors in New York lately it was resolved, on the recommendation of the consulting engineers of the Company, that the contract for two or three alternators, each of 5,000 h. p., should be assigned to the Westinghouse Electric and Manufacturing Company of Pittsburgh. I would wish to state how much we owe to Mr. Westinghouse, and to his chief engineer, Mr. Schmid, for the zeal with which they have taken this matter up and their desire to meet our views and to secure for us machines of which they felt they could guarantee the satisfactory performance.

Before leaving the subject of the dynamo, I would wish to point out that it has been designed for special circumstances in connection with the Cataract Construction Company's work. If a dynamo of the same type were being constructed for another place, it is certain that modifications would have to be introduced. I particularly draw attention to the fact that some trouble in getting out a good mechanical design arose from the necessity which existed of being able to provide a clear space of about 5 ft. diameter in the middle of the machine without taking the whole machine to pieces, the object of this being to enable us to lift up portions of the turbine shaft which it might be required to put into repair. In any case, where the long shaft existing in our case is not required, the design of the dynamo is much simplified and would more nearly approximate to the first design but arranged for 33 periods a second.

If the present paper were intended to relate solely to the subject of the utilization of power at Niagara Falls I would be content with describing what has actually been done; but I foresee that there is going to be a great development in utilization of water power and its electrical transmission. I am, therefore, inclined to say a few words on some other details which we have been carefully considering, but about which no definite decision has been arrived at.

Before doing this I would direct your attention to the drawing[1] representing a plan of our power house, in which you will perceive the inlet passages A, from the great canal, B, which draws its supply of water from the upper river. From these inlet passages the iron pipes or flumes, C, pass vertically downwards to the bottom of the great wheel-pit, which is a slot cut in the ground to a depth of nearly 200 ft., at present large enough to contain four turbines in line, but which can be extended to a much greater length, the whole capacity of our tunnel being 100,000 h. p. The drawing shows circles, D, in the plan, which indicate the position of the turbine and dynamo above it, and the position of a hatchway F, by which material can be raised or lowered. It will be noticed that between the inlet channels and the wheel-pit the flumes are bent downwards, and thus leave a V-shaped space G, which I have appropriated to make a subway, running along the whole length of the power-house, to carry the high-pressure conductors. It will, of course, be understood that the slot forming the wheel-pit is arched over at the top to form the floor of the power-house, upon which the dynamos rest. It will be noticed that at the north end of the power-house there is a large square chamber, H, in which I propose that all the measuring instruments and other apparatus under the control of the chief electrician shall be assembled. Underneath this chamber there is a cellar in direct communication, first, with the subway which I have described as existing in the power-house; and, second, with the subway which leads outwards from the power-house at present as far as the Pittsburgh Reduction Company's works, and may possibly eventually lead to Buffalo. In this cellar all the high-pressure wires, the transformers, the artificial load, and other high pressure machinery will be placed. It will be noticed that other spaces are left in the floor forming trenches along which the conductors can be carried With these arrangements there can be no possibility of danger to any person in the power-house; and if any wires are to be found laid along the walls of the power-house or elsewhere, I wish it to be a maxim that we shall be able to place upon these wires a card marked "No Danger," so that there will be no possibility of danger from any person touching anything in the power-house.

With regard to the exciting current, the best plan available at this moment is to use one of the machines which are generally known as the Schuckert machines, for converting the alternating into a continuous current, transformers being inserted in order to lower the pressure. In order that the exciting current may increase with the load, it would be well to make these transformers of special construction, each having two primaries and one secondary. One of the primary coils would be in series with the main circuit, and the other in shunt. I would furthermore make these transformers sufficiently large to deal with all the dynamos which are in the central station, and I would subdivide the secondary coil into sections, to enable us to cut out a section of the transformer when we cut out one of the dynamos. When we wish to cut out a dynamo, a switch would be worked which would at the same time short-circuit the field coils of that dynamo and also cut one section of the secondary of the transformer which is supplying exciting current to all the dynamos. This plan allows the fields of all the alternators to be put in series—a desirable arrangement for parallel working. A resistance may, of course, be put in circuit with the fields of the alternators for regulation.

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[1] The drawings accompanying Prof. Forbes' paper are not yet available for publication.—Eds. E. E.

I presume it will be taken for granted that in any large work of this sort the primary circuit should never be broken when in action. For my part, I hold that this should be the case even in smaller stations.

An important feature for putting the dynamos in parallel, and for removing a dynamo, is an artifical load. It is desirable that this artificial load should consist partly of a resistance and partly of self-induction. It is only by this means that the dynamo which is going to be put in circuit can be brought to exactly the same condition as those which are working, both as regards volts and amperes. It may be well to describe the operation which take place when a dynamo is switched in parallel with the others. First, connection is made between the armature and the artificial load; then the exciting switch is turned so that an extra section of the transformer is put into play, and the short-circuit on the field coils of the dynamo is broken. The dynamo being excited, the turbine is then started, or this may be done at first. The artificial load is then adjusted until the dynamo is giving the same volts and amperes as the others. A synchronizer is then placed between the artificial load and the external circuit, and so soon as the synchronism is attained a switch is closed which connects the artificial load with the external circuit. Resistance is then put into the artificial load until there is very little current going through it, when it is switched out, and the dynamos are all working in parallel. To cut out a dynamo from the circuit the operations are performed in the opposite order. The artificial load with high resistance is put in connection with the external circuit; the resistance is gradually diminished until it indicates the amount of work that is being performed by one dynamo; the connection between the artificial load and the main circuit is then broken, leaving the dynamo (which is being switched out) feeding the artificial load. The resistance of the latter may then be increased, and the exciting switch actuated so as to short-circuit the fields of the dynamo, and to remove one section from the secondary of the exciting transformer. The supply of water to the turbine may then be shut off.

If machinery is worked, even at 20,000 volts, in the manner I have described, there is no possibility of injury from any great rise of electrical pressure, unless the external circuit be by any means accidentally broken. To provide against this sort of trouble I would have wires coming from the external circuit where it enters the power-house, connected through a large resistance, or through the primary of a transformer, the secondary of which contains a resistance. In circuit with it I would have a break consisting of two carbon points at a distance of about half an inch apart if we were dealing with 20,000 volts, so that an arc could not be formed unless the pressure rose above the normal value. Under these circumstances, so soon as any resonant effect due to the breaking of the circuit or due to any other cause raises the electric pressure above the normal, an arc is established across the carbon points, and so a load is put on which removes the cause of the extra high pressure. This is the only automatic means which I have been hitherto able to think of which is sufficiently rapid in its action to overcome any possibility of injury to the dynamo or transformers.

I have attempted in the course of this Paper to give you some idea of the work which has been actually done or decided upon at Niagara Falls, and also to show you the views to which I have been led by any special experiences which I may have had as to the general ideas which ought to guide us in the construction of plant in the future for transmitting power to a distance electrically.

In describing the different plans which are available I have avoided mentioning the names of those numerous electrical engineers and manufacturers who, by their inventions, researches, or applications have advanced the art; or discussing their claims to priority; but I cannot conclude this Paper without mentioning the names of some of those who, in one way or another, have made great steps in the applications of alternating currents to power purposes. I would particularly mention the names of Messrs. Ganz and Co., Mr. Schuckert, the Allgemeine Electricitâts Gesellschaft (of Berlin), the Oerlikon Fabrik, and Messrs. Brown, Boveri & Co.; also Mr. Eickemeyer, Mr. Ferranti, Prof. Ferraris, Prof. Fleming, Dr. J. Hopkinson, Messrs. Hutin and Leblanc, Mr. Rankin Kennedy, Prof. Mengarini, Mr. Mordey, Mr. Tesla, Prof. Elihu Thomson, and Mr. Henry Wilde. I feel that all of us owe a great deal to their work.

In conclusion, I wish to draw attention to the figures which show the relative merits of high and low frequency with polyphase motors.

Everything is identical in the two figures, except that, the frequency of one (*a*) being double of the other (*b*), *a* has 16 poles, *b* has 8. The armature is identical in both, and revolves at the same speed and does the same work; and the field revolves at the same rate in both, and the induction and current-density are the same. The differences are that *a* has more copper and less iron than *b*. The comparison of efficiency depends on the depth of both. As an example, assume that *a* has 50 per cent. more copper in the fields than *b*, the ampere-turns per pole being necessarily the same in both, and that *b* has 50 per cent. more iron than *a*, and that the hysteresis loss in *b* (= H_b) is equal to the resistance loss in its copper coils (= C_b). The values for *a* are—

$$H_a = 2 \times \frac{2}{3} \times H_b\,;$$

$$C_a = \frac{3}{2} C_b\,;$$

$$H_a + C_a = \left(\frac{4}{3} + \frac{3}{2}\right)\frac{H_b + C_b}{2} = 1.42 \times (H_b + C_b).$$

Thus the total losses in the field of higher frequency (neglecting eddy-currents) are 42 per cent. more than in the field of lower frequency.

LITERATURE.

How to Wire Buildings. By Augustus Noll, E.E. New York, 1893. C. C. Shelley. 162 pages, 5½ x 8 inches. Price $1.50.

IN this utilitarian age when practice keep so closely at the heels of theory the successful workman in any branch must fortify himself in every way if he is not to be outdistanced by his more studious fellows. This demand for more knowledge has given rise to a host of so-called "practical" books intended to convey to the artisan the results of actual experience, as distinguished from the theory or laws on which the subject treated of is based. But there are two kinds of "practical" works. One of these is the result of a gathering together of materials and knowledge acquired by hearsay, as it were, and frequently the outcome of much painstaking labor on the part of the authors. Such works have a certain value, but they almost invariably fall short of their intended purpose by lacking those small but all-important details which serve as the links that join the whole together and the knowledge of which makes the successful workman.

The other type of the "practical" book is that which is written by one who has actually done the things which he describes, who knows in just what manner they are carried out most conveniently and expeditiously and who is thus in a position to note the little, all important details above alluded to. It is of this second type that Mr. Noll's book is an excellent example. Himself a successful workman (in the true sense), of long and varied experience, he is eminently qualified to describe to others what he has himself found to give the best results in practice.

In these days of Boards of Fire Underwriters and numberless wiring rules and constant threats of increased insurance rates on buildings lighted by electricity it is specially desirable to put into the hands of every one connected with the installation of a lighting plant, from the architect down to the wireman, a source of correct information, and the work before us is the first of its kind which can be said to meet broadly the requirements.

The author in carrying out his design first gives us a series of considerations governing wiring work in general, and introduces here the duties and qualifications of a wiring foreman. That all-important question of the location of the conductors serves to bring out forcibly the value in a work of this kind of that personal experience about alluded to. Throughout all this section of the book we read between the lines the instances of the "troubles" encountered in the past, the removal of which has often been accomplished at the cost of much time and money. The way "how not to do" work of this kind is here forcibly brought home to the reader. The location of the conductors, with reference to the other numerous adjuncts to modern buildings, having been discussed, the author takes up the question of the division of circuits and distribution of current, and the laying out of wiring plans, and here again Mr. Noll's ripe experience is manifested. He describes clearly, and by the aid of diagrams, the "panel" or "grouping" system, and various other systems, and the means to be adopted for obtaining equal pressure throughout the system, and pointing out the situations in which one or the other will be found to be most advantageous. The wiring from converters is also fully explained and shown by diagrams.

That later outgrowth of necessity, conduit wiring, has afforded the author opportunity of showing the beauty and value of this system to its fullest extent, and the methods of carrying out such work are treated with corresponding fullness in a well-illustrated chapter.

Not the least important part of work of this nature is the location of the lamp outlets in order to obtain the best illumination. On this subject, that is, the distribution of light, we find much of value, especially to the architect, on whom the duty of selecting the proper location of lamps usually falls. In addition to the general rules found in the past to give the best lighting effects, a number of special cases are added and considered, such as the lighting of show windows, churches, theatres, paintings, etc. We also find a special chapter devoted to stage and theatre wiring which is replete with practical hints and suggestions.

As the work is intended also as a guide and aid to those in charge of isolated lighting plants, the author has included a number of useful chapters on kindred topics, such as insulation, appliances, connections, fuse wire, pulleys, belting, the setting up and running of dynamos and motors, and also on the duties of the engineer in charge.

Throughout the volume we find practical examples of wiring worked out by simple methods which can be followed by any one having a knowledge of simple arithmetic, with accompanying tables of safe carrying capacity, etc.

A feature of the book are the excellent diagrams which might well be used as models by those engaged in laying out wiring plans. If to all this we add a most pleasing literary style of treatment of the subject, Mr. Noll's work will be found to have a charm not often met with in books of such a strictly technical character. We may be pardoned if we make use here of the trite expression, that no one in any way connected with the installation or care of an electric light plant can afford to be without this book.

REPORTS OF COMPANIES.

CHANGES IN GENERAL ELECTRIC OFFICES.

In accordance with the policy of economy and retrenchment that has been carried out for some time past by its executive committee, the General Electric Co. has now decided to move its "main offices" to Schenectady, where the largest works are. As a result of this change, preparations are already being made for the transfer to Schenectady of various departments heretofore located at New York, Boston and Lynn, and every vacant house or room in the old Dutch town is being rapidly taken up. There will thus result a notable concentration of the manufacturing, selling and engineering forces of the company, and it is believed that much expensive delay and friction will be avoided. The departments moved include the Lighting, Power, Mining, Railway, Supply and Accounting, as well as the Engineering. This will necessitate the removal to Schenectady of the Engineering Staff from Lynn, and the heads of all these departments will also have to make the like change. It has been rumored that Prof. Elihu Thomson would move to Schenectady, but this is obviously untrue. A large amount of manufacturing of staple goods will still be done at Lynn, but it is the intention to handle heavier work at Schenectady on account of its superior facilities. The executive offices will remain in Boston as heretofore. The Company will retain offices at 44 Broad st., New York, where the Eastern District will continue its headquarters and the executive officers and heads of departments will use them as necessity or convenience of business requires.

These changes will naturally have some effect on the District Offices, into which the policy of retrenchment is also being pushed; but it will be a few months before all the necessary readjustments will be clearly seen or made. The Eastern District, will, as stated, continue in New York, but important changes or reductions have been begun in Washington and Pittsburgh. Western business will, it is understood, be almost wholly handled from Chicago.

COLLEGE NOTES.

THE ROBERTS CORRESPONDENCE SCHOOL OF TECHNOLOGY.

Mr. E. P. Roberts has added to the faculty of his Correspondence School, Brainard Block, Cleveland, Mr. George T. Hanchett, a graduate of the Boston Institute of Technology, and a man of considerable practical experience. Mr. Hanchett learned the trade of machinist, and worked his way through college, a fact that will give peculiar value to his instruction. Local courses in analytical geometry and calculus by Mr. Hanchett, and roof trusses and bridge building by Mr. F. C. Osborne have just started, and the local class in civil engineering begins this month. Mr. Roberts finds that having the local class is of very great assistance in presenting the matter to his correspondence students, as the staff are thereby enabled to anticipate many of the questions that would be asked them. They give a local lecture on the subject, then revise it, paying special attention to the snags on which the local students have struck. The school is now educating men in every section of the country, and has many inquiries from Canada.

LEGAL NOTES.

EDISON PHONOGRAPH LITIGATION.

MR. EDISON VS. THE EDISON UNITED PHONOGRAPH CO.

Suit for $1,000,000 damages has been begun by Thomas A. Edison in the New Jersey Supreme Court against the Edison United Phonograph Company. The alleged damages are represented to have been done the plaintiff through the sales of phonographs in this country and abroad by the defendants.

The Edison United Phonograph Company has also begun a suit against Thomas A. Edison, the Edison Phonograph Company and the North American Phonograph Company for $400,000 damages claimed to have been done the plaintiff's business by the defendant companies in selling phonographs in foreign countries.

PERSONAL.

Prof. I. Thornton Osmond who has for some years been developing a course of electrical engineering in the Department of Physics in the Pennsylvania State College, has succeeded in getting the trustees to make a separate electrical engineering department. He will now devote himself again strictly to scientific work in physics. Prof. Osmond has favored The Electrical Engineer with many interesting contributions.

Mr. Newton Hall, who for some time past has been connected with one of our most esteemed electrical contemporaries, has resigned his position, and is now interested in the American Electrical Publishing Co., with headquarters at 136 Liberty street. He is the assistant manager of this new concern, and in that capacity will have charge of the publications which it will issue, notably the *Electrical and Street Railway Reporter*, a journal to make its first appearance March 1 as a monthly. Combined with this journal will be July and January issues called Directory Editions, whose character is described in their title. Mr. Hall has long made a specialty of this class of work, in which his past success, accuracy and experience will now prove of great value. If Mr. Hall gives us a really good Electrical Directory all will be forgiven.

OBITUARY.

A. C. WHITE.

The death of Mr. A. C. White, who was well known in telephone circles, took place on the 27th of December at his home in Boston. Mr. White was born in North Dighton, Mass., in 1858. He had been associated with telephone interests for the past seven years. A graduate of the Massachusetts Institute of Technology in 1882, where he completed the regularly prescribed course in physics, he at once entered the electrical field, in which he was to become so active a worker. His studies at the Institute of Technology were entered upon with a distinct leaning towards electrical matter, and the marked ability shown by him in his work was later testified to by his appointment as lecturer at the Institute on some of the commercial aspects of electric lighting.

His first position on graduting was with the U. S. Electric Lighting Company in Boston. While there he did some work on the arc light which led to an ingenious experimental method of regulation depending on the sudden change in the E. M. F. of the arc in passing from the hissing to the silent condition. The results of this work were published at the time in an English electrical periodical. His association with the U. S. Company terminated in 1884. At that time he went West, and was until 1888 connected with the Western Edison Company in Chicago. It was during his association with these two active companies, at a time when electric lighting was making great progress in being introduced in this country and when problems to be solved cropped up in rapid succession, that Mr. White obtained the great fund of experience and practical knowledge of all the details of the electrical business for which he was so well and favorably known by those in the fraternity who came into contact with him.

In 1886 he entered the employ of the American Bell Telephone Company in Boston. The principal result of his labors in this field was the invention of the present Long Distance Transmitter—known to telephone men as the "Solid Back Transmitter"—which has contributed in a remarkable degree to the development of the long distance service.

Mr. White was a member of the American Institute of Electrical Engineers, the Society of Arts, and the Mathematical Physical Society. A wife and young daughter survive him.

SOCIETY AND CLUB NOTES.

UNIVERSITY EXTENSION LECTURES TO ELECTRICAL WORKERS.

THE excellent educational work that is now being done by means of what is known as University Extension lectures and studies furnishes remarkable evidence of the general public desire for fuller information and instruction on the subjects that cannot well be taught at school and yet are ordinarily beyond the reach of those who are unable to attend a college course. In England, where it originated, the plan of University Extension may be said to have risen to the dignity of a "national movement," so widely and successfully has it been applied; while in this country admirable results have already been attained on similar lines. New York State has given generous support to the idea, and in this city Columbia College has taken the work in hand with the vigor and the enthusiasm that are so rich with promise for her splendid future.

Under the auspices of Columbia College, the organization known as the Brotherhood of Inside Electrical Workers has formed a University Extension Club, whose membership is already running up to 500. In this club each member subscribes $2 for a course of ten lectures on practical electrical subjects, but the lectures will also be thrown open to anyone who is willing to spend 25 cents each time for the privilege of listening to any special one or two. Toward this praiseworthy scheme, so entirely creditable to a trade organization, President Low has himself contributed $1,000, while the various firms in the Electrical Contractors' Association have also given substantial financial proof of their support of the movement. In this way the expenses will be met, including those of the hire of the large hall at Cooper Union, the use of apparatus and current, and the use of lantern and other auxiliaries. The course of lectures arranged is as follows:

Jan. 15.—Batteries, Primary, Secondary and Thermo. Mr. C. O. Mailloux.

Jan. 22.—Alternating Current Dynamos, Motors and Transformers. Mr. Wm. Stanley, Jr.

Jan. 29.—Direct Current Dynamos and Motors. Dr. Schuyler S. Wheeler.

Feb. 5.—Electrical Measurements. Mr. A. E. Kennelly.

Feb. 12.—Electric Lighting. Prof. F. B. Crocker.

Feb 19.—Street Railways. Mr. T. C. Martin.

Feb. 26.—Power. Mr. Nikola Tesla.

March 5.—Telegraphs. Mr. Wm. Maver, Jr.

March 12.—Telephones. Mr. J. J. Carty.

March 19.—Alarms. Mr. Wm. Maver Jr.

A very interesting feature is that these lectures, each of which is to be a plain, straightforward explanation of the subject, will be followed by class work. The instructor in charge will give a short talk on the subject of the preceding lecture. This talk, which will be in the nature of a "review," will embody answers to questions that have been submitted to him in writing. This work will be in charge of Mr. W. H. Freedman, tutor in electrical engineering at Columbia College, and will be most valuable to all who participate in it. Members will also be helped by syllabuses and by lists of good books to read in connection with any preferred branch of study.

BROOKLYN INSTITUTE OF ARTS AND SCIENCES.

Before the Electrical Department of the Institute, of which section Mr. James Hamblet is president, on Friday, Jan. 5, Mr. A. W. R. Peirce of the Crocker-Wheeler Electric Co. read a paper on "The Dynamo: Its Construction and the Principles of Operation." The lecture was largely attended, a delegation from the electrical class at the Pratt Institute augmenting the regular numbers. Mr. Peirce handled his subject in a delightful way, illustrating his remarks by blackboard drawings and by parts of dynamos and portions of machines in the process of construction. In the course of his remarks he referred to the Davenport motor which has been thoroughly illustrated and described in THE ELECTRICAL ENGINEER, and which is now in this office as a valued relic.

DR. PUPIN ON "ELECTRICAL RESONANCE" BEFORE THE NEW YORK ELECTRICAL SOCIETY.

THE next meeting of the New York Electrical Society will be held at Columbia College, on Tuesday, Jan. 16, at 8 p. m. Prof. Michael I. Pupin will deliver a lecture on "Electrical Resonance," accompanied by interesting experiments showing the properties and influence of self-induction and capacity on electric circuits.

AUSTIN ENGINEERING CO.

THE officers of the Austin Engineering Co. who represent in Pittsburgh, Pa., the Altoona (Pa.) Mfg. Co., builders of the M. A. Green automatic cut-off engines, have been removed from 514 Lewis Block to 51 Schmidt Building, 95 Fifth Avenue.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED DECEMBER 26, 1893.

Alarms and Signals:—

Electric Bell, A. J. Oehring, Chicago, Ill., 511,451. Filed Apl. 25, 1891.

Fire Alarm Telegraph, C. H. Rudd, Chicago, Ill., 511,462. Filed May 19, 1892.

Employs two electro magnetic helices in different parallel branches of the alarm circuit adapted to act in opposition to each other upon an armature, heat responsive devices adapted to open the circuit, a resistance coil in one of the branches, mechanism controlled by the armature for sending the alarm signal, and a ground branch from the main circuit.

Electric Signaling Apparatus, T. B. Doolittle, Bridgeport, Conn., 511,731. Filed Feb. 13, 1893.

Claim 2 follows:

A visual signal indicator comprising in combination an electro-magnet, a casing and a bodily-moving inductive armature confined in said casing and having its movements limited thereby, the casing being provided within a suitable aperture for the display of the armature.

Conductors, Conduits and Insulators:—

Electric Wire Covering, F. S. Randall, Philadelphia, Pa., 511,547. Filed June 2, 1893.

A covering consisting of raw cotton in bulk.

Insulator, C. N. Hammond, Boston, Mass., 511,611. Filed Sept. 1, 1892.

Insulator, C. N. Hammond, Boston, Mass., 511,612. Filed Apl. 12, 1893.

Galvanic and Thermo-Electric Batteries:—

Galvanic Battery, H. T. Johnson, New York, 511,434. Filed April 21, 1893.

Employs a containing cup forming the positive electrode, a semi-solid filling with the cup, and a negative electrode having an uneven surface and embedded in the filling.

Process of and Composition for the Manufacture of Porous Cups for Electric Batteries, F. G. Curtis, Philadelphia, Pa., 511,514. Filed Feb. 13, 1893.

Distribution:—

Electric Transformer, J. J. Wood, Fort Wayne, Ind., 511,574. Filed May 19, 1893.

Relates especially to the sub-division of the respective laminæ of the envelope of an iron clad transformer.

Dynamos and Motors:—

Governor for Electric Motors, J. Marty, Jr., Cleveland, O., 511,347. Filed Oct. 10, 1892.

Has the commutator bars arranged helically instead of straight and means for shifting the brushes in the direction of the commutator axis.

Method of and Means for Compounding Dynamo Electric Machines, E. Thomson, Swampscott, Mass, 511,375. Filed Nov. 28, 1892.

Claim 1 follows:—

The method of sustaining or increasing the E. M. F. of a dynamo electric machine, which consists in magnetizing pole pieces adjacent to the polarized part of an armature by induction from the armature itself.

Electric Locomotive, J. G. McCormick, Louisville, Ky., 511,448. Filed April 1, 1892.

Has for its principal object to mount the armature independently upon the axle of the car so that the momentum will be delivered directly to the axle and the revolution will be coincident with that of the wheels.

Current Regulator for Dynamo Electric Machines, C. D. Haskins, Brooklyn, N. Y., 511,523. Filed Nov. 12, 1892.

Employs an electro magnetic device for shifting the brushes.

Electrical Transmission of Power, N. Tesla, New York, 511,559. Filed Dec. 8, 1888.

The invention consists in passing alternating current obtained from one original source throught both of the energizing circuits of the motor and retarding the phases of the current in one circuit to a greater or less extent than in the other. See THE ELECTRICAL ENGINEER, Jan. 3, 1894.

System of Electrical Power Transmission, N. Tesla, N. Y., 511,560. Filed Dec. 8, 1888.

Similar in its object to No. 511,559.

Rotary Electro Magnetic Engine, H. P. White, Kalamazoo, Mich., 511,570. Filed Feb. 15, 1893.

Employs a multipolar armature rotated upon its axis by the combined forces of elementary magnetic attraction and repulsion and also by the tendency of a magnetic pole to move past the electrified wire.

Electric Motor Apparatus, W. A. Johnston, A. W. Browne and J. C. Davidson, Prince's Bay, N. Y., 511,621: Filed April 25, 1893.

Relates to application of electric motors to the manipulation of dental apparatus.

Lamps and Appurtenances:—

Electric Arc Lamp, R. Belfield, London, Eng., 511,495. Filed April 5, 1893.

Employs a rocking feeding mechanism carrying a geared sector actuating a toothed wheel, and a pendulum plate embracing the toothed wheel, and engaging it with inwardly extending teeth.

Rosette for Electric Lights, C. N. Hammond, Boston, Mass. 511,613. Filed June 30, 1893.

Has projections on the side serving as binders for the feed wire, and having guides for the lamp cord strands permitting the latter to be connected with the feed wires at the point protected by the flanges.

Fire Guard for Lamp Cords, E. E. Angell, Somerville, Mass., and S. Porter, Boston, Mass., 511,720. Filed April 20, 1893.

Measurement:—

Electric Measuring Instrument, E. Thomson, Swampscott, Mass., 511,376. Filed March 2, 1893.

A combined voltmeter and ammeter arranged to register either volts or amperes by the throwing of a single switch, and provided with a double scale by which its indication may be read in the desired unit.

Electric Meter, L. Brillié, Paris, France, 511,401. Filed Nov. 22, 1893.

A meter in which an electro dynamometer serves to control the speed of a motor exerting an opposing tendency on the dynamometer through the medium of a magnetic retarder.

Electric Measuring Apparatus, T. Bruger, Bockenheim, Germany, 511,503. Filed June 21, 1887.

The invention consists in the combination with a stationary polarized solenoid, of a double solenoid, the succession of the poles of which is positive negative and negative positive, said double solenoid being mounted co-axially to the stationary solenoid and adapted to move over the same.

Miscellaneous:—

Method of Electric Commutation and Fluid Electric Commutator, C. E. Emery, Brooklyn, New York, 511,328. Filed Dec. 28, 1892.

The invention consists of a method of commutation in which the current is conveyed from the conductors to the commutator sections by means of a circulating conducting fluid.

Process of and Apparatus for Manufacturing Ozone Gas, E. Fahrig, Marseilles, Ill., 511,330. Filed June 18, 1892.

Process of Making Resistance Plates. C. E. Carpenter, Bridgeport, Conn., 511,407. Filed Feb. 7, 1893.

Relates to a special insulation of the Carpenter enamel rheostat.

Process for the Manufacture of Paraamidophenol Sulphonic Acid, A. A. Noyes and A. Clement, Boston, Mass., 511,450. Filed Mch. 16, 1893.

Carbonizing Apparatus, I. L. Roberts, Brooklyn, N. Y., 511,459. Filed Dec. 8, 1892.

The process consists of placing the articles to be carbonized in a mass of sand or like non-conducting material and passing a current of electricity through a conductor in contact with the mass.

Safety Device for Electric Circuits, C. H. Rudd, Evanston, Ill., 511,461. Filed Dec. 10, 1888.

Consists of a high resistance shunt around the lamps connected to ground so as to provide a high resistance path for static discharge.

Machine for Separating Magnetic from Non Magnetic Substances, G. G. Crosby, New York. 511,512. Filed Jan. 11, 1893.

Patrol Box, W. Eglin, Philadelphia, Pa., 511,599. Filed Jan. 19, 1892.

Electrolyzing Apparatus, A. J. O. Chalandre, Paris, France, 511,682. Filed Sept. 13, 1893.

Electric Cautery Apparatus, J. A. Wotton and E. A. Bostrom, Atlanta, Ga., 511,742. Filed June 26, 1893.

Electric Grain Weighing Scale, J. and D. De P. A. Outcalt, Spotswood, N. J., 511,647. Filed July 8, 1893.

Railways and Appliances :—

Conduit Railway Trolley, J. C. Love, Chicago, Ill., 511,342. Filed May 17, 1892.

Employs a contact device consisting of a grooved shoe and means for supporting it so as to allow lateral oscillatory movement.

Trolley for Conduit Railways, J. C. Love, Chicago, Ill., 511,343. Filed May 17, 1892.

Relates especially to the contact devices and means for supporting them upon the car.

Support for Electrical Conductors, J. C. Love, Philadelphia, Pa., 511,344. Filed Jan. 21, 1893.

Employs two gripping plates whose jaws engage the conductor and a support comprising a two part socketed clamp, and insulating material surrounding the plates when in the socket of the lamp.

Tension Device for Electric Conductors, J. C. Love, Philadelphia, Pa., 511,345. Filed Jan. 21, 1893.

Has for its object to maintain a constant longitudinal tension upon the trolley wire to avoid sag between its points of support.

Trolley Bar Carrier for Cars, J. C. Love, Philadelphia, Pa., 511,346. Filed Jan. 21, 1893.

Trolley Wire Crossing, H. Geise, Philadelphia, Pa., 511,419. Filed June 26, 1893.

Claim 1 follows:

A crossing device comprising, in combination, conducting wires insulated at the point of intersection and crossing each other at a point above the normal level of the wires, and a travel plate provided below the point of crossing and upon which the trolley wheels of both lines are adapted to travel.

Conduit for Electric Railways, H. D. Oler, Paterson, N. J., 511,452. Filed Aug. 23, 1892.

The invention consists in the combination with a conduit of a conductor held in a longitudinal groove in blocks in the conduit, sliding blocks in said groove and swinging members in the conduit and actuated from a wheel on the car for successively bringing the several blocks in contact with the conductor.

Converter System for Electric Railways, G. E. Hesse, Brooklyn, N. Y., 511,524. Filed Nov. 21, 1892.

Employs a rail having branches wound with insulated wire so that the rail itself may be used as a primary magnet.

Electric Railway Switching Mechanism, C. J. Kintner, New York, 511,627. Filed June 24, 1893.

Relates to sectional conductor systems in conduit railways.

Telephones and Apparatus :—

Telephone, B. Pickering, Dayton, O., 511,858. Filed Jan. 29, 1881.

A combined telephone, microphone and alarm.

Telephonic Instrument, P. Rabbidge, Sydney, New South Wales, 511,456. Filed Apl. 22, 1893.

Employs a spring armature distinct from the diaphragm and enclosed within the receiver case, and a gravity switch cutting out the alarm circuit when the receiver is in use.

Multiple Switchboard System for Telephone Exchanges, C. E. Scribner, Chicago, Ill., 511,464. Filed Apl. 26, 1893.

Telephone System, F. R. Colvin, New York, 511,589. Filed June 26, 1893.

Has for its object to permit telephonic intercommunication between a plurality of stations without a central exchange.

Telephone System, J. J. McNally, California, Mo., 511,739. Filed Aug. 31, 1893.

Has for its object to automatically make connection between one station and another.

THE ENGINEERING MAGAZINE FOR JANUARY.

In the shape of a souvenir of the World's Fair, the *Engineering Magazine* has issued a superb January number, which carries out in a most admirable manner the aim to indicate the practical value of the Fair in stimulating science and industry. It has an illuminated cover, 82 pages of special illustrations, 158 pages of illustrated articles and 124 pages of advertisements, a total of nearly 370 pages of the single issue, the price of which, as usual, is only 25 cents. Mr. J. R. Dunlap, editor and proprietor, deserves hearty felicitations on such a magnificent production, which certainly marks the highest point ever reached in monthly technical journalism. Many of the contributions to the issue are of interest to electrical engineers. There is a contrast between electricity in 1876 and 1893, by Prof. Elihu Thomson; an excellent electrical department, by Mr. F. L. Pope, and a discriminating review of Cox's "Continuous Current Dynamos and Motors," by Mr. Nelson W. Perry.

ELECTRICAL EXECUTION.

A BILL is to be pushed in the Massachusetts Legislature legalizing execution by electricity.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

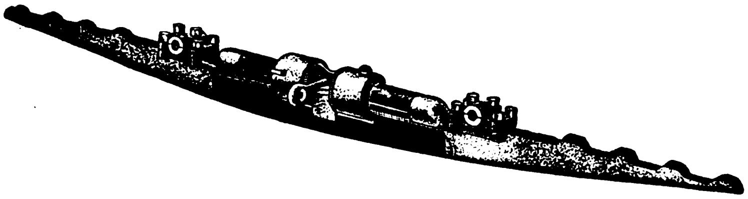
THE "ACME" PORTABLE TESTING SET.

QUEEN & Co., incorporated, Philadelphia, are making a renewed push of their "Acme" portable testing set, which was temporarily withdrawn from the market because of certain small defects which have now been overcome in a thoroughly satisfactory manner. This type succeeds the "T305" form, which met with a large sale, though it was much more bulky and heavier than the present style—besides lacking the essential feature of a battery. The "Acme" set is "multum in parvo" in completeness and compactness, while it can be used under every possible condition as to electrical fields or mechanical vibrations. For testing the resistance of dynamos, motors, lamp filaments, line wire and in fact whenever "ohms" are to be measured, an engineer or expert will find it an apparatus that can be relied upon to work well.

After a careful test the U. S. Government has informed the makers that the set will be accepted for service on ship-board in the Navy, where the requirements are extremely exacting. In addition to this a World's Fair diploma was awarded Queen & Co. for "Testing Sets and Standard Resistances," so that they feel well pleased with the commendation which has been accorded to their resistance measuring apparatus. Circular No. 445 will be mailed upon application.

ÆTNA SECTION INSULATOR.

THE insulator illustrated in the accompanying engraving has been severely tested before placing on the market. It is of simple design, strong and durable. The wooden piece between the terminals is renewable and can be changed while on the line. A convenient clamping device renders it possible to leave enough trolley wire coiled on top of the section insulator, to allow of its being let out to repair the line in case of a break.



ÆTNA SECTION INSULATOR.

Another part of this combination clamp holds the feed wire in such a way as to obviate the necessity of stripping the insulation from the wire, except at the part held by the clamp. By this arrangement the feed wire is left insulated from the poles to the section insulators and between the line where there is a double track.

The insulation is Ætna, and no hood is necessary to protect the insulation. Of the several hundreds already in use none have been provided with hoods and results of this insulator are reported as highly satisfactory. It is manufactured by Albert & J. M. Anderson, of Boston.

WHAT CONSTITUTES A MERRY CHRISTMAS.

THE ELECTRIC APPLIANCE COMPANY of Chicago, have been having a particularly merry Christmas principally on account of the fact that they were able by dint of hard hustling to get their entire trade supplied with copies of their latest edition of catalogue and for the past week have been in receipt of numerous congratulatory letters complimenting its completeness, attractive appearance and intelligent arrangement. It is unnecessary to state that a great many of the letters were accompanied with a substantial proof of appreciation in the shape of large orders for material selected from the new book.

ASSIGNMENT OF THE RAILWAY EQUIPMENT CO.

Mr. W. R. Mason, general manager of the Railway Equipment Co., Chicago, has notified the trade that as a result of the existing depression, it has been found advisable and prudent to make an assignment. Mr. Geo. O. Fairbanks has been appointed assignee. Mr. Mason looks for but a temporary difficulty and asks for a continuance of support.

THE SIMPLEX ELECTRIC CO. has moved its offices from 622 Atlantic avenue, Boston, to 75–81 Cornhill, that city.

UNITED COLUMBIAN ELECTRIC CO.

THE apparatus of the above company for electric railway work, has already been described in our pages. The president of the company, Mr. Hewitt Boice, is pushing its interests in a manner that promises well for its success. Mr. Boice has had a business career that qualifies him admirably to direct such an enterprise. A resident of Kingston, N. Y., he has extensive blue stone quarries on the line of the Ulster & Delaware Railroad, and has been engaged in the stone industry for 20 years. The bulk of the blue stone used in New York City is furnished by him, and from his properties come also the immense blocks of finished stone used for sidewalks on the Astor and Vanderbilt properties. Some time ago, Mr. Boice recognized the ability and ingenuity of Mr. Winkler, in work that has often been referred to in our columns; and he has given the necessary assistance and backing to the efforts which have brought the Winkler "twin motor" to its present successful stage of development. Electricity has always depended much upon such aid and confidence on the part of farsighted and courageous capital, and it is the hope of all that Mr. Boice will find every expectation realized in entering so actively into the already enormous field of electric railway development.

JAS. I. AYER & CO.

THE following notice which will be of great interest to the electric lighting community has just been issued in St. Louis. Mr. Ayer is well known as a central station manager and as a president of the National Electric Light Association:

> We offer our services as Electrical Experts and Consulting Engineers, for the designing of and superintending the complete construction of Electric Lighting Plants of every character; Street Railway Power Plants and electrical construction; adjusting insurance Losses on electrical apparatus; examinations of and reports on the Physical and Financial Condition of electrical properties; estimates and formulating Contracts; electrical plans and specifications for Architects and similar work.
>
> We have to recommend our services for this work Mr. Ayer's experience of more than ten years' in designing, constructing and operating electric plants of different characters, embracing arc and incandescent plants for central stations, power plants for electric work, and isolated plants for buildings, together with his thorough knowledge of the practical requirements in the operation of electrical apparatus and the management of electrical properties.
>
> The plant of the Municipal Electric Lighting and Power Company, of St. Louis, one of the largest in the world, was designed and constructed by him, and operated under his management until its absorption by other lighting interests.
>
> Mr. Ayer is a member of the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers.
>
> Mr. Broughton graduated at Cornell University in 1890 as a Mechanical and Electrical Engineer, and has been engaged for more than three years in practical work in the installation and operation of electrical apparatus of all kinds used for lighting and motor power.
>
> JAS. I. AYER,
> ST. LOUIS, January 1st, 1894. H. P. BROUGHTON.

NEW PRICE LIST OF THE COLUMBIA INCANDESCENT LAMP COMPANY.

THE following advice has reached us from the Columbia Incandescent Lamp Co. of St. Louis:—

We beg to advise you after the 10th day of January, the price of Columbia lamps will be as follows:—

10, 16 and 20 c. p. lamps	$0 32½	net.
25 c. p. "	.35	"
32 c. p. "	.50	"
50 c. p. "	.75	"
Special Railway and Anchored Filament	.37½	"

The above prices are for barrel lots and over. For less quantities than barrel lots 2½ cts. each will be added.

The same high grade of the Columbia lamp will be maintained. We are enabled to make this reduction by reason of the magnificent support which has been given us by users of incandescent lamps throughout the United States during the past year, which has enabled us to largely increase our manufacturing facilities and add additional machinery which has reduced the cost.

THE PETTINGELL-ANDREWS' CALENDAR.

THE PETTINGELL-ANDREWS CO., dealers in electrical supplies at 192–202 Summer street, Boston, have sent each of their friends one of the most attractive advertising calendars that have been issued this year. The calendar proper is of just the right size and is printed in good, heavy, dignified black figures, while on the card is an excellent monochrome representing an ocean steamship bravely battling the waves. A frame for the picture is suggested by an armored cable enclosing one corner, its ends lost in the flying spray, and a piece of Interior conduit at the diagonally opposite corner. The name of the company appears above, surmounted by the ever-present Okonite trade mark, and a heavy coil of "P. A." triple braid line wire floats gaily on the crest of a wave alongside the ship as it is rapidly wafted before the wind, hotly pursued by a flock of gulls who have mistaken it for a dough nut.

EMERSON ELECTRIC MFG. COMPANY.

THE EMERSON ELECTRIC MFG. COMPANY, of St. Louis, is at present engaged in making a number of handsome switchboards according to drawings and specifications received from companies desiring such apparatus. Besides the general business of the Emerson Electric Mfg. Company, this class of work is now becoming a specialty with them, and they will be glad to make estimates upon switchboards under any specifications that may be furnished.

PRICE OF BEACON LAMPS REDUCED.

ALTHOUGH very much improved lately in all essential qualities, the Beacon lamps are now being offered to the public at a reduced price. In lots of 1,000 or over, the 16 c. p. lamp will cost 30 cents; in barrel lots of 200, 32 cents, and in smaller quantities 35 cents. The Beacon Vacuum Pump and Electrical Company, Irvington street, Boston, invite correspondence from manufacturers desirous of making their lamp under a license.

ALUMINUM MANUFACTURE AT NIAGARA.

A DISPATCH of recent date from Lockport, N. Y., says: Negotiations which are practically completed, it is understood, are being made for a compromise of the litigation between the Cowles Electric Smelting and Aluminum Company of Lockport and the Pittsburgh Aluminum Company by a consolidation of the two. In the event of union the entire local plant will go to Niagara Falls, where the Pittsburgh Company is preparing to build a factory which will be the largest electric aluminum smelting concern in the world.

MR. F. R. CHINNOCK.

MR. F. R. CHINNOCK, who for the past two years has been the general eastern agent of the Ball Engine Co., of Erie, Pa., has resigned his agency of that company and will again enter the electrical field, with which industry he was so long identified before taking up the sale of engines.

Mr. Chinnock feels that he will be still more successful in the field of electricity in which line he met with much success as an agent of the Edison General Electric Co., with which his many friends will remember he was associated for eight years.

NEW YORK NOTES.

MR. HARRY W. COLBY formerly with the General Electric Co. and the Mather Electric Co., has opened offices in the Central Building, Liberty street, for the Holtzer-Cabot Electric Co. of Boston. The New York office will handle the Holtzer-Cabot dynamos and motors for the entire country outside of New England.

THE SCHULTZ BELTING CO., of St. Louis, through their New York office at 225 Pearl street, have recently shipped to Yokohama, Japan, as the result of a small order sent out some time ago, two 11" dynamo belts, the aggregate length being 115 feet. They have also furnished new belts for the Central Opera House, New York. In this latter installation one of the chief features is the exclusion of the much-talked-of air cushion, and the fact that the belts can be run very slack, and noiselessly, without deteriorating the strength of the leather.

THE CONSOLIDATED CAR HEATING CO., Albany, N. Y., has received a second order from England for direct steam storage heating equipments. These equipments are so arranged that the temperature in each compartment can be separately regulated. The C., ., C. & St. L., otherwise known as the "Big Four," the Lehigh Valley, the New York, Ontario and Western, the Fall Brook, the Connecticut River and the Boston and Albany Railroads have recently abandoned all other patterns of steam couplers and have made the Sewall coupler their standard. The Consolidated Car Heating Co., Albany, N. Y., has sold over 10,000 Sewall couplers since the beginning of the present heating season.

THE ACCUMULATOR CO., of 224 Chestnut street, Philadelphia, announce that they are now putting on the market their standard accumulators greatly improved in mechanical design and construction. They will be glad to quote prices.

MR. WALTER C. MCKINLOCK, secretary of the Metropolitan Electric Company of Chicago, has just returned from a successful business trip and reports the outlook for his new company as very promising. The company are now handling the Blair adjustable lamp hanger, which enables the lamp to be raised or lowered automatically.

THE PERKINS ELECTRIC SWITCH COMPANY, of Hartford, Conn., have decided to open an office in Boston, and have taken room 71, Hathaway Building, 620 Atlantic Avenue, with Mr. F. B. Smith in charge. Mr. Smith will carry a full line of all the Perkins well-known specialities, and will thus be able to fill all orders promptly from stock.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. JANUARY 17, 1894. No. 298.

THE PRACTICAL ECONOMY OF ELECTRIC HEAT COMPARED WITH THE BLAST FURNACE.

BY

Isaiah L. Roberts

THE art of electric heating has progressed so far that no one now doubts its utility in some few arts such as electric welding and cooking, while even others, more bold, have ventured to apply it to heating rooms and cars. There are still others who dream of the time when electric heat will be about the only heat used for any purpose. The vast majority of people will say that it will be a long time before the blast furnace is displaced by the electric furnace, because so much heat is required in such a case that it can never be generated economically be electricity. I shall endeaver to show here briefly that this dream is not so far off as it appears, and is not only possible but can be made practical at the present time if suitable furnaces are constructed.

At first thought one is inclined to imagine that where low heats are required electricity would be most economical in use, but in fact it is just the reverse. At the present price of electric energy, houses cannot be heated so economically as by steam or water but where any substance or space is to be heated above or near a red heat electric heat can be applied cheaper than any other, regardless of the shape, size or nature of the article to be heated. I have proved the above assertions by the most careful tests, a few of which I will describe here.

Let us take the simplest and easiest case first, namely, the heating of a conductor. I used for this test a platinum wire about five centimetres long and two millimetres thick. A glass alcohol lamp filled with absolute alcohol, wick well saturated and the whole glass capped, was weighed on a pair of good chemical scales. In a thin glass beaker containing 40 c. c. of water a small thermometer reading in fractions of a degree was placed and the whole brought to the temperature of the room.

The room was kept within two degress of a constant temperature by a thermostat connected to a steam coil valve. The alcohol lamp was lighted, the wire held by a pair of pliers at as near one end as possible and held in the flame at the most favorable angle possible to get the most heat. When it showed color from heat it was removed and instantly dropped into the water. The water was stirred with the thermometer until thoroughly mixed, and the rise in temperature noted. This was repeated with different sizes of the flame and at higher and lower temperatures so as to find the most economical point of loss of alcohol, the lamp being instantly extinguished, capped and reweighed to ascertain the loss. The same wire was then clamped between two copper clamps so that as little of the wire touched the clamps as possible. To these were attached a voltmeter, and an ammeter was placed in the circuit of the electric current. The current was switched on and timed until a color was shown in the wire about the same as was shown in the flame, when it was quickly released and dropped into the water. The stirring and reading of the thermometer, as well as the time and reading of the instruments, were all gone through with and repeated at different temperatures up to incandescence of the wire, as well as at very slight heats.

The results were then compared. Figuring the amount of electric energy as against the thermic power of alcohol lost, it was found that in the case of the alcohol, less than one half of one per cent. of the heat generated had got into the wire at a red heat while about ninety per cent., of the electric energy was recovered as heat.

It was thought that while this was fair for the electricity it was not fair to the alcohol. So two wires, each half the weight and about the same length as the original one, were used with better results, while four of one quarter the weight showed still better; but even by such subdivision, which in practice would be very unfair to electricity, there was still shown to be about 30 per cent. margin in favor of the current.

The next set of experiments was conducted in well-made furnaces and under equally favorable conditions, except that in the use of charcoal as the heating agent, the best fuel possible was employed, namely, dry charcoal. A well-jacketed fire-brick lined furnace was used, and a proper charge of coal of selected sizes was placed in the furnace to the best advantage and fired until it was well aglow. Then a piece of a square iron shaft, weighing about one kilogram, and 20 centimetres long, was provided; also a pail of water, thermometer, and large, though accurate and fine-reading, scales. The furnace was placed on the platform and weighed. While burning full of coal, the iron was thrust in the centre of the coal when the furnace was well heated and draught open. When a red color appeared in the iron it was taken out, dropped into the water, and the change in weight of furnace noted; also the rise of temperature of the water was figured against the calorific equivalent of the carbon lost. This was repeated again with two pieces of iron half the weight, and then with four of one quarter the weight, so as to give the coal the best possible chance to act on the iron. I may state here that the proportions of the quantity of metal core to that of the coal was that prescribed by the best blast furnace practice. The large bar was then placed in the jaws of a Thomson welding machine and heated to a red heat and thrown into the same quantity of water at the same initial temperature and the rise noted; this rise was then figured against the electric energy consumed in heating.

Comparative results showed that in the furnace where the single heavy bar of iron was heated, about ¾ of one per cent. of heat generated found its way into the iron, while even when divided up, so as to favor the coal, only about 2 per cent. was recovered; while in the electrically heated piece, about 88 per cent. of the current was recovered as heat. It was found that urging the fire by a blower made the time shorter but greatly decreased the economy of the furnace. In order to get even the results shown, the heat had to literally soak into the iron from the coal and walls of the furnace; while in the case of the current, the iron in a single piece was heated in about two minutes.

The third and last set of tests was made on non-conducting crucibles which were of good Hessian make. The crucibles each contained two kilos of brass scraps and turnings covered by suitable flux and one set in the charcoal furnace and properly fired, the fuel being charcoal of selected sizes and the size of the crucible being that best suited to the size of the furnace. The other crucible of same size and weight was put in a furnace especially made for that purpose and adapted to the work, and the construction of which the writer hopes to give in a subsequent communication.

The charcoal furnace was well fired before the crucible was put in. The crucible and contents were then weighed and placed in the furnace on a bed of live coals and well and quickly packed around with fresh, dry, selected charcoal, which was also weighed. The fire was given the requisite and most economical blowing until the brass was melted, when the crucible was removed and the furnace was weighed and the loss of carbon noted.

The electric furnace was then heated until it was as near the temperature that the charcoal furnace was, so far as could be judged, and then the crucible was set in and the current consumption from that moment noted until the brass was fused, when the last reading was taken.

The result of these tests was that the calculations showed the efficiency for the charcoal furnace to be about $1\frac{1}{2}$ per cent., while the electric furnace had an efficiency of about 85 per cent. It must be here noted that water tests for temperature could not be made, because of the great heat and mass; but the specific heat was calculated from data well known to the physicist.

No claim is made for these tests that they were more than approximately exact, because in the water tests some heat escaped as steam when the red hot metal was thrown in; but the comparison was almost perfect, and that is what was desired more than accuracy.

These tests prove conclusively the claims set forth by the writer in the beginning of this article. The reason for this is not difficult to understand. Heating by combustion, from its nature, must be accompanied by bulky apparatus, as fuels must have an abundance of air for proper combustion. Therefore to utilize this heat to its greatest advantage, large and comparatively cool surfaces must be presented. The steam boiler and gas engine are the best instruments known for this purpose, and thanks to the great engineers of our day they can convert 10 per cent. of the heat of flame into mechanical energy. The electrician can convert 90 per cent. of this, or 9 per cent. of the energy of combustion into electricity and thus 8 to 9 per cent. of the flame heat can be put electrically into the thing heated, whereas with a direct method even in a large blast furnace where the fuel is mixed with the iron, not over 6 per cent. of the fuel is actually utilized to smelt the iron.[1] The application of electric heat to brass and iron foundries, to glass, pottery, and enameling furnaces and especially to the art of baking carbons, can now be practically carried out with great economy in fuel and time, if properly constructed furnaces are used.

From the results of these tests it is perfectly safe to say that from $\frac{1}{2}$ to $\frac{9}{10}$ of the fuel now used for the above purposes can be saved if its heat be first converted into electricity.

PRIVATE TELEPHONES IN AUSTRALIA.

So long as a squatter keeps his telephone on his own property, says the *Melbourne Argus*, he is quite within his rights, but if his wires cross a public road he renders himself amenable to the law, which forbids a private person to erect a telephone or telegraph, the monopoly being reserved for the Government. The Colonial Postmaster-General does not wish to prohibit telephones under such circumstances, and he has, therefore, had regulations prepared, which have been passed by the Governor in Council, charging a license fee of £1 per mile per annum for the first four miles, and after that 10s. per mile; the fee, however, in no case to exceed £7 per annum. The height at which the wire must be carried across roads is specified, and it is also provided that in no case shall a fee be charged or accepted for the use of the line.

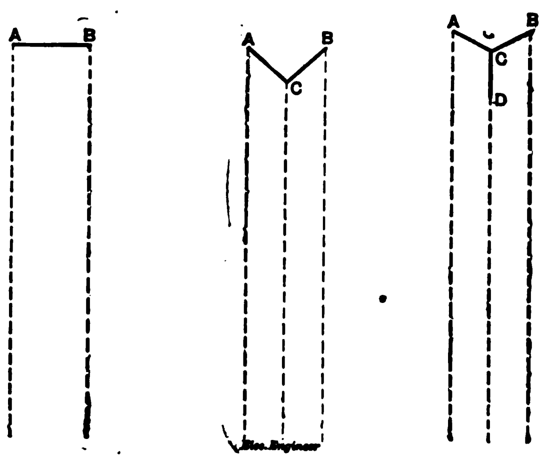
RELATIVE ECONOMY OF COPPER IN SINGLE-PHASE, TWO-PHASE AND THREE-PHASE TRANSMISSION.

BY

W L R Emmet

In the report of Prof. George Forbes' paper on "The Electrical Transmission of Power from Niagara Falls," begun in The Electrical Engineer, of December 20th, the following statement is made:

> **With regard to the relative merits of two and three phases, several claims that cannot be supported have been put forward in favor of the latter. First, it is claimed that the saving in copper on the line is 25 per cent. over a one-phase system, and 25 or 18 per cent. over two-phase system, according as four or three wires are used for the purpose. I investigated this matter carefully, and arrived at the conclusion that this was not the case, and that the three-phase system had no advantage in this respect over a two-phase system with three wires.**



Figs. 1, 2 and 3.

In a paper read before Section "G," of the British Association on September 18 last, Mr. Gisbert Kapp makes the following statement:

> **If we put all the systems on the same footing as regards efficiency and safety of insulation, we find the following, viz: If for the transmission of a certain power over a given distance by continuous current, 100 tons of copper are required for the line, then the single-phase alternating, and the two-phase four-wire system will require 200 tons, the two-phase three-wire system will require 290 tons, and the three-phase three-wire system only 150 tons. As far as the line is concerned, there is thus a distinct advantage in the employment of the three-phase system.**

The facts concerning which these gentlemen disagree are of great importance, since the use of multiphase apparatus is daily increasing, and every user has to decide between the two and three-phase systems, each of which is advocated by one or more of the large electrical companies of the country. That the figures given by Mr. Kapp are correct within the premises he assumes, is easily shown by the process given below.

Figs. 1, 2 and 3 represent three circuits arranged, respectively, on single-phase, two-phase three wire, and three-phase systems. The dotted lines represent the line wires which are all assumed to be of equal length. The full lines represent the portions of circuits on which work is done or light furnished. We will assume that the maximum potential difference between any two wires in each of these circuits is the same, and equal to E; also that the energy in watts in the useful part of the circuits in each case is equal to W, and that the energy lost in lines in each case is the same and equal to K. M and N are constants which reduce the quantities which are expressed in maxima to mean values, then apply in the same manner to the corresponding quantities in each case.

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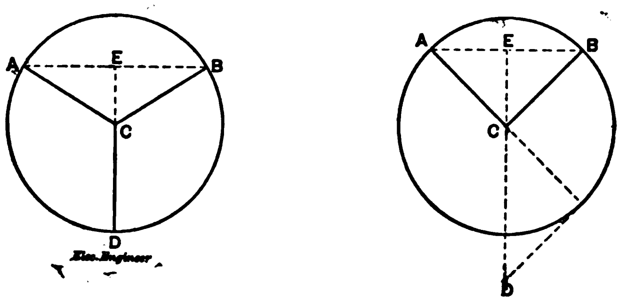
[1] See a Paper read by Sir Lowthian Bell, Bart., F. R. S., before the Iron and Steel Institute, Darlington, England, Sept., 1893.

In Fig. 1 the current in each of the line wires is $\frac{W M}{E M}$ and the resistance of each of the wires is $\frac{K}{2} + \frac{W^2 N}{E^2 N}$, and the conductivity of each is $\frac{2 W^2}{E^2 K}$. Hence the total conductivity in line wires is $\frac{4 W^2}{E^2 K}$.

In Fig. 2 the maximum potential difference between the points A and B being E, the maximum difference between B and C will be $\frac{E}{\sqrt{2}}$. In Fig. 5, in which A C and B C represent the maximum potential differences between the points A and C, and B and C, Fig. 2; and the angle A C B is equal to the difference of phase of these quantities which in the two-phase system is 90 degrees. Then A B = B C $\sqrt{2}$ will equal the maximum potential difference between A and B, or E, by the simple relation of periodic quantities, the variations being assumed to be sinusoidal. The current in each of the branches A C and A B, Fig. 2, will then be $\frac{W}{2} \times \frac{\sqrt{2}}{E} M = \frac{W M}{E \sqrt{2}}$. These currents flow in the line wires from A and B, and they combine at C to form a current in the line wire from C which will bear the same relation to either of the currents which form it that A C or A B bear to C D, in Fig. 5. These two combining currents are equal and differ in phase by 90 degrees. Hence the current in line wire from C is $\frac{W M}{E M}$. Thus the total current carried on the three wires over the single length of the line is $\frac{W}{E} \times (1 + \sqrt{2})$. The total energy loss in lines being K, the total conductivity of the three wires which carry this current must be $\frac{W^2}{E^2 K} \times 5.83$.



FIGS. 4 AND 5.

In Fig. 3 the three circuits A C, B C and D C carry equal currents, two of these currents which differ in phase by 120 degrees uniting to form a periodic current equal to each of those from which it is formed. If A C and B C, Fig. 4, represent in quantity and phase the currents at A and B, Fig. 3, then C D will represent in quantity and phase the current at D, Fig. 3, and if B C and A C, Fig. 4, represent the corresponding potential differences in Fig. 3, then A B, Fig. 4, represents the maximum potential difference between wires which exists on the system, this being assumed equal to E. The maximum difference between the point C and any of the points A, B or D is $\frac{E}{\sqrt{3}}$. Then, since the total energy is W, the current in each branch is $\frac{W M}{3} \times \frac{\sqrt{3}}{E M} = \frac{W}{E \sqrt{3}}$. The total current carried the single length of the line is $\frac{W}{E} \sqrt{3}$, and since the $C^2 R$ loss in the line is K the total conductivity must be $\frac{W^2}{E^2 K} \times 3$.

Hence the conductivities required are found to be in the proportion of 4, 5.83 and 3. These proportions are the same as between the numbers 200, 291, and 150 which correspond to the copper weights given by Kapp. Since the only limitation of economy in copper in any line is determined by the pressure which can be safely and conveniently generated and handled, it would seem that no rational basis of comparison can be assumed other than that from which these figures are derived; namely, the assumption, that in lines of equal length equal amounts of energy are transmitted, and equal amounts are lost in lines, with equal strain on insulation and danger from shocks.

THE LEWIS ELECTRIC CAR LIGHTING SYSTEM.

AMONG the many details of railway operation the lighting of the cars has occupied the attention of railway managers as much, perhaps, as any other. Although the dangerous character of oil and also of gas, is well recognized, progress in the application of the electric light has been very slow, especially in this country, so that we find but very few trains now equipped with this method of illumination.

In the early experiments in this field, cars were provided with individual sets of batteries charged at terminal stations. It was soon found, however, that the change of batteries required at the end of each trip, and the liability of the charge becoming exhausted before the end of the trip was reached, made this method too uncertain and troublesome. As a result, the plan was adopted of supplying the cars with batteries which are kept constantly charged from a dynamo placed in the baggage car, and driven by a steam engine supplied with steam from the locomotive boiler. Though this plan has worked more satisfactorily than the previous one, it still has its drawbacks in that it drains the boiler directly of steam required for traction purposes and not infrequently on heavy grades the dynamo has to be stopped in order to maintain the speed of the train. Besides that, it makes the installation an expensive one, and the plant occupies valuable room in the baggage car. It was early suggested to drive the dynamo from the car axle, but with the swiveling trucks employed on American railways this method of driving has heretofore introduced difficulties which have until recently rendered it unsuccessful, although with the rigid trucks employed abroad it has met with fair success.

The prime essentials of any such system, subjected to the severe conditions obtaining in railway practice, are simplicity, that is, ease of handling, and economy both of operation and first cost. It was with these objects in view that Lieut. Isaac N. Lewis, U. S. A., some time ago attacked the problem. He has now succeeded in developing a system of car lighting which seems to possess all the elements of a successful commercial apparatus.

The Lewis system which has been experimented with on a car of the New York Central Railroad consists essentially of a dynamo driven from the car axle, supplying current to a set of storage cells which furnish current during the period of stopping of the train, and during other periods, as will be explained presently.

The dynamo is mounted on the truck and consists of a four pole iron-clad machine completely enclosed so as to exclude all dust, and provided with graphite bearing for the armature shaft. The armature is driven directly from the axle by means of spiral spring flexible "belting" which is capable of responding to all the movements of the truck, and thus obviates all necessity for equalizing arrangements such as belt tighteners, idlers, etc., to keep the belt taut.

The dynamo, of 1 k. w. capacity weighs barely 200 pounds and readily finds room on the truck. The current is led into a battery of 11 cells and these feed the 20 volt lamps of which there are 12 to each car.

Being driven directly from the car axle some means must of course be provided first for maintaining the direction of the current supplied to the batteries uniform, and at the same time cutting out the dynamo when its speed falls so low as to bring its E. M. F. below that of the storage batteries on the car. Again the arrangement must be such that the dynamo potential remains practically constant no matter at what speed the car is running. All these necessary requirements have been worked out with great simplicity by Lieut. Lewis. A uniform direction of the current is maintained by a polechanger while the cut-out, operated by a governor on the dynamo shaft, interrupts the current when the speed of the car falls below that required for the charging of the cells. The uniformity of potential at varying speeds is controlled entirely by a particular and simple method of winding of the dynamo, and no auxiliary regulating apparatus of any kind is employed. Throughout a range of current from 0 to 35 amperes, for which the dynamo is designed, the E. M. F. does not differ 1 volt, at all the varying speeds, from the point at which the dynamo is cut in up to the maximum.

The cutting out of the current from the dynamo below a certain speed relieves the locomotive of all work, when the battery is not charging; as a consequence, also, the dynamo does not act as a drag on the locomotive when starting. The means by which all these operations are performed are exceedingly simple but we regret that the exigencies of patent matters now pending prevent us from publishing them at this time.

The Lewis system is controlled by the Lewis Electric Co., of this city, of which Mr. Henry E. Fanshawe is vice president and Mr. V. H. Bridgeman, treasurer, with Lieut. Lewis as electrician. Besides the car fitted up on the New York Central Railroad, a number of cars on other roads will shortly be equipped so that the system will soon have a crucial test.

NON-ELECTROLYTIC DISSOCIATION.

A CONTRIBUTION to the dissociation hypotheses has been made by M. Wildermann, who regards two kinds of dissociation as possible, namely, electrolytic dissociation into ions, and non-electrolytic dissociation into larger molecular aggregates of the dissolved substance into smaller aggregates. This new assumption which is elaborated in the *Berichte*, xxvi., pp. 1,773–86, appears to be of use, in so far as it is sufficient to explain the divergencies and discrepancies existing between the observed data and numerical values calculated on the electrolytic dissociation hypotheses alone. The author also discusses, in this paper, the electrical conductivity of salt solutions which do not in general obey the dilution law applicable to weak acids and bases. He then discusses the matter mathematically, and deduces formulæ which show a qualificative agreement with the experimental data.

MISS MARY A. HENRY's interesting account of the life work of her father, Joseph Henry will be continued in our pages next week.

MR. JESSE VAN ZILE ANTHONY, manager of the Middletown, N. Y. Electric Light & Power Co. has married Miss Frances James of Jersey City Heights, N. J.

THE TELEPHONE PATENT SITUATION.—I.

WHEN the fundamental Bell patent, No. 174,465 expired on March 7, 1893, it was thought by some that the telephone receiver at least was free, and individuals and companies started cautiously and tentatively to make telephonic apparatus. Those who did so, however, soon had their attention called, by the American Bell Telephone Co., to the structural patent on the receiver of Jan. 30, 1877, which, with the fundamental patent above referred to, was sustained by the Supreme Court. The Bell Company also immediately after March 7, 1893, changed its well worn advertisement, appearing in the electrical papers and elsewhere, to read as follows :—

> THE AMERICAN BELL TELEPHONE CO.,
> 125 Milk street, Boston, Mass.
>
> This Company owns the Letters Patent No. 186,787, granted to Alexander Graham Bell, Jan. 30, 1877, the scope of which has been defined by the Supreme Court of the United States in the following terms :
>
> "The patent itself is for mechanical structure of an electric telephone to be used to produce the electrical action on which the first patent rests. The third claim is for the use in such instruments of a diaphragm, made of a plate of iron or steel, or other material capable of inductive action ; the fifth, of a permanent magnet constructed as described with a coil on the end or ends nearest the plate ; the sixth, of a sounding box as described ; the seventh, of a speaking or hearing tube as described for conveying the sounds ; and the eighth, of a permanent magnet and plate combined. The claim is not for these several things in and of themselves, but for an electric telephone in the construction of which these things or any of them are used."
>
> This company also owns Letters Patent No. 463,569, granted to Emile Berliner, Nov. 17, 1891, for a Combined Telegraph and Telephone and controls Letters Patent No. 474,231, granted to Thomas A. Edison, May 3, 1892, for a Speaking Telegraph, which cover fundamental inventions and embrace all forms of microphone transmitters and of carbon telephones.

This alone did not deter enthusiastic manufacturers of telephones, and it became necessary for the Bell Company to bring suit in Pittsburgh, Pa., against the Shaver Corporation and its licensee company at McKeesport, Pa., praying for an injunction, and citing the patent of Alexander Graham Bell, of Jan. 30, 1877, No. 186,787, as the one infringed. The injunction was promptly granted as were subsequent injunctions against other infringers. The advertisement which is quoted above gives the scope of the patent as defined by the Supreme Court, and, as the patent will expire on the 30th of this month, the claims are here printed in full, in order that readers may learn exactly what will then be open to the public :

CLAIMS.

1. The union upon, and by means of, an electric circuit of two or more instruments, constructed for operation substantially as herein shown and described, so that, if motion of any kind or form be produced in any way in the armature of any one of the said instruments, the armatures of all the other instruments upon the same circuit will be moved in like manner and form ; and if such motion be produced in the former by sound, like sound will be produced by the motion of the latter.

2. In a system of electric telegraphy or telephony, consisting of transmitting and receiving-instruments united upon an electric circuit, the production, in the armature of each receiving-instrument, of any given motion by subjecting said armature to an attraction varying in intensity, however such variation may be produced in the magnet, and hence I claim the production of any given sound or sounds from the armature of the receiving-instrument, by subjecting said armature to an attraction varying in intensity, in such manner as to throw the armature into that form of vibration that characterizes the given sound or sounds.

3. The combination, with an electro-magnet, of a plate of iron, or steel, or other material capable of inductive action, which can be thrown into vibration by the movement of surrounding air, or by the attraction of a magnet.

4. In combination with a plate and electro-magnet, as before claimed, the means herein described, or their mechanical equivalents, of adjusting the relative position of the two, so that, without touching, they may be set as closely together as possible.

5. The formation, in an electric telephone, such as herein shown and described, of a magnet with a coil upon the end or ends of the magnet nearest the plate.

6. The combination, with an electric telephone, such as

described, of a sounding box, substantially as herein shown and set forth.

7. In combination with an electric telephone, as herein described, the employment of a speaking or hearing tube, for conveying sounds to or from the telephone, substantially as set forth.

8. In a system of electric telephony, the combination of a permanent magnet with a plate of iron or steel, or other material capable of inductive action, with coils upon the end or ends of said magnet nearest the plate, substantially as set forth.

While the expiration of this patent this month will free the receiver (which instrument can also be used as an inferior transmitter) there still remain, protected by patents, a number of special forms and modifications of the receiver and certain improvements in magneto telephone transmitters. Quite a number of patents bear upon the shape and arrangement of the permanent magnet or magnets, with reference to the diaphragm,—such as types of "crown magnetos," etc.—while others, like Phelps, No. 222,201 of December 2, 1879, refer to methods of construction conducive to better articulation. Manufacturers of telephone receivers who propose to depart from the regular form, will do well to look up carefully these many minor patents.

The receiver being free, how about the transmitter?

It seems to be thought by some that, because under the operation of Section 4887, of the Revised Statutes, the Blake patents have expired in this country, the Blake transmitter is free; the patents of Francis Blake, however, do not of themselves cover the Blake transmitter; these patents are subordinate to Berliner, 463,569 of Nov. 17, 1891—the famous "Berliner Patent"—and also Edison, 474,231 of May 3, 1892, besides the other two Edison microphone patents of May 3, 1892, numbered 474,230 and 474,232 respectively. Then there is the re-issued patent of Berliner, No. 9,499 of December 14, 1880, upon the induction coil, which has so far been ignored by writers on the telephone patent situation. This patent was originally No. 199,141, and issued on Jan. 15, 1878. It therefore has one year to run, during which time the induction coil can not be used without infringement. Then there is the patent of Watson, No. 217,561, of July 15, 1879, upon the attachment of the polished button to a metal back, which also has a bearing on the question. Section 4887 of the Revised Statutes has been referred to above and, as it has a most important bearing upon the subject, it is printed here in full, although it is doubless familiar to many readers.

SECTION 4887, REVISED STATUTES OF THE UNITED STATES.

No person shall be debarred from receiving a patent for his invention or discovery, nor shall any patent be declared invalid, by reason of its having been first patented or caused to be patented in a foreign country, unless the same has been introduced into public use in the United States for more than two years prior to the application. But every patent granted for an invention which has been previously patented in a foreign country shall be so limited as to expire at the same time with the foreign patent, or, if there be more than one, at the same time with the one having the shortest term, and in no case shall it be in force more than seventeen years.

The fate of the Edison patents under this section of the patent law will not be known until a final decision in the Bate Refrigerator litigation; both the life of the Edison lamp patent and the Edison transmitter patents hang upon the decision in this case. What has still to be decided is, what bearing, if any, has the date of application of the American patent, with reference to the date of application of the foreign patent? In interpreting Section 4887, the Circuit Courts have held that the dates of domestic and foreign applications were irrelevant. It is now contended in the new Bate case, that "previously patented in a foreign country" should be taken to mean *previously applied for* in a foreign country. The case of Bate Refrigerator Co. *vs.* Sulsberger, *et al*, decided June 7, 1893, *pro forma* in favor of the defendants, according to previous Circuit Court opinions, was appealed. It was expected to be argued, in the United States Circuit Court of Appeals, in New York, in December, but has been deferred.

In the case of the Edison transmitter patents the application was made in the United States Patent Office prior to the foreign application; yet the English patent was issued, ran fourteen years and expired, before the United States patent was issued.

For a great part of this period the applications of Berliner and Edison were in interference. As is well known, during these many years of delay in the Patent Office, the Bell Company owned both sides of the interference. Now if, in the Bate Refrigerator Case, the Court shall decide that the date of application of the United States patent controls, then the Bell Company will have the protection of the Edison patents for seventeen years from May 3, 1892, and this protection it will have even though it be defeated in the government suit now pending against it in Boston to annul the Berliner patent. In the Bate Refrigerator case, it is generally thought that the fate of the Edison lamp patent is the principal thing to be decided; the Westinghouse Electric and Manufacturing Co. are supposed to be interested in confirming the interpretation that Section 4887 means that the date of issue controls; while the General Electric Co., the owners of the Edison lamp patent, contend that the date of the United States application as compared with that of the foreign application controls. While these two companies and the general public are interested in the Refrigerator case from the incandescent lamp point of view, the American Bell Telephone Co. and the public (if the public only knew it) are a thousand fold more interested from a telephone transmitter point of view; and it is a significant fact that Mr. F. P. Fish, counsel of the General Electric Co., is also of counsel for the American Bell Telephone Co. The latter company is not known in the case, but in the event of a favorable decision it will profit far more than will the General Electric Co.

It is assumed, in some recent articles on this subject that the Edison transmitter patents are admittedly void. If the existing interpretation of Section 4,887 by the Circuit Courts had been finally approved by the Supreme Court, the above assumption would stand.

It has been erroneously assumed that the Bell Company desired delay in the Government suit to annul the Berliner patent; in an editorial in THE ELECTRICAL ENGINEER of January 3, it was pointed out that such was not the case, and why it was not. The fact is, on the contrary, the Bell Company has every reason to desire a decision at as early a date as possible; while Judge Taylor, of Government counsel, says that Mr. Storrow (of Bell Co.'s counsel) and Attorney General Olney are trying to hurry him, but he won't be hurried. The truth of the matter is that the case is now going forward with all possible dispatch in Boston, and will probably come to argument in May of this year. It is a question whether the Bell Company are justified in stating in their advertisement that the Berliner and Edison patents "embrace all forms of microphone transmitters and of carbon telephones," for the reason that a form of such instrument may be conceived that does not depend for its action upon the variation of "pressure between electrodes in constant contact." It is doubtless true that no transmitter patent has as yet issued that does not include dependence upon variable pressure for its action, but it cannot be predicated or predicted that a transmitter, and a carbon transmitter at that, may not be invented that shall act in an entirely different manner.

As no single article of moderate length can do justice to the transmitter patent situation, it may be appropriate to close this instalment with the claims in full of the Berliner and principal Edison transmitter patents.

Claims of Patent of Emile Berliner, Application filed June 4, 1877, Patent issued Nov. 17, 1891:

1. The method of producing in a circuit electrical undulations similar in form to sound-waves by causing the sound-waves to vary the pressure between electrodes in constant contact so as to strengthen and weaken the contact and thereby increase and diminish the resistance of the circuit, substantially as described.

2. An electric speaking-telephone transmitter operated by sound-waves and consisting of a plate sensitive to said sound-

waves, electrodes in constant contact with each other and forming part of a circuit which includes a battery or other source of electric energy and adapted to increase or decrease the resistance of the electric circuit by the variation in pressure between them caused by the vibrational movement of said sensitive plate.

3. The combination, with the diaphragm and vibratory electrode, of a rigidly-held opposing electrode in constant contact with the vibratory electrode, substantially as described.

4. In a telephonic transmitter, a vibrational plate made concave for condensing the sound, substantially as set forth.

5. In a telephonic transmitter, a vibrational plate provided with one or more apertures, as and for the purposes set forth.

6. A speaking-telephone transmitter comprising a diaphragm or disc sensitive to sound-waves, combined with a rigidly-held but adjustable electrode in contact with the same, whereby the electric current is transformed into a series of undulations corresponding with the vibrations of said diaphragm.

Claim of Patent of Thos. A. Edison, Application filed July 20, 1877, Patent issued, May 3, 1892. Patented in England, July 30, 1877, No. 2009:

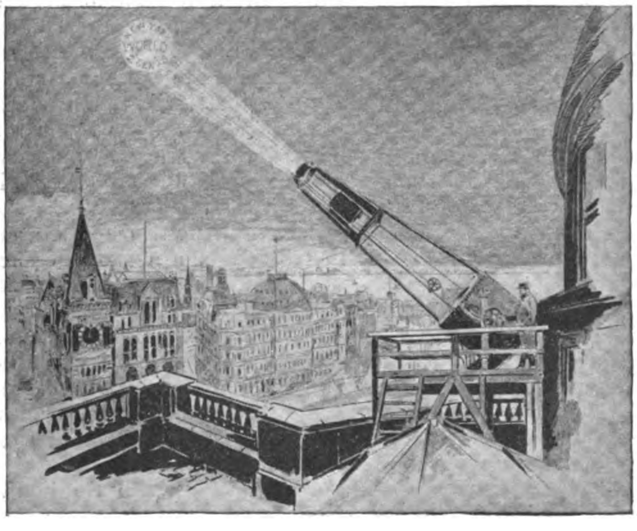
Claim:

In a telegraphic apparatus operated by sound, the combination, with the diaphragm, of one or more contact-points of plumbago or similiar inferior conductor in the electric circuit, whereby the rise and fall of electric tension is proportionate to the pressure exerted upon the said point or points by the diaphragm, substantially as set forth.

THE ROGERS ELECTRIC CLOUD PROJECTOR.

One of the closing electrical features of the World's Fair at Chicago was the Rogers electric cloud projector which, placed on the roof of the Manufactures Building informed the gathering multitude of the number of visitors during the day and drew their attention to numerous other things by projecting words and pictures on the clouds. The apparatus used at Chicago has now been transferred to New York by its inventor, Mr. L. K. Rogers of the Brush Electric Co. It has been placed on the roof of the Pulitzer Bdg., on Newspaper Row, opposite the City Hall Square, where its announcements now attract the attention or thousands on favorable nights.

Our illustration made from a drawing for which we are indebted to the *New York World*, gives a very clear idea of the apparatus employed. It consists of an electric focussing lamp, whose rays are projected outwardly by a 30-inch Mangin reflector. The arc itself is not placed in the focus of the projector but some distance forward of that point, so that the rays are directed upon a 10-inch condensing lens which brings them into parallelism. At the end of the arm projecting from the cylindrical case is placed a focussing lens, the position of which can be regulated by means of the hand-wheel and chain shown.

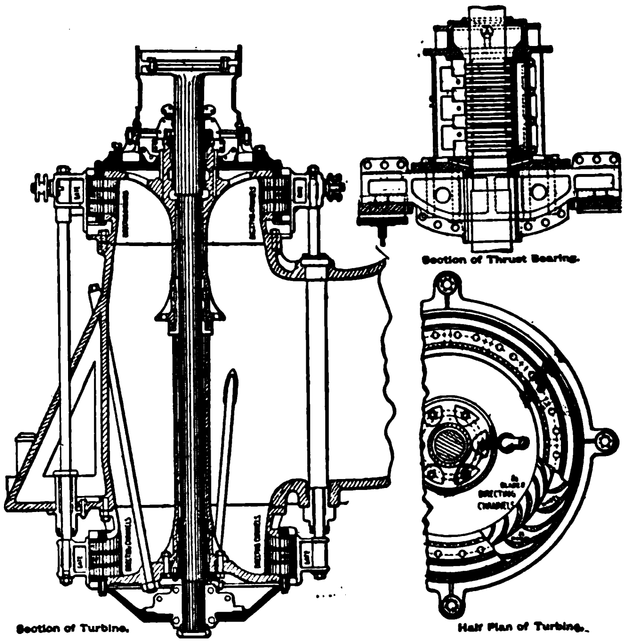


THE ROGERS ELECTRIC CLOUD PROJECTOR.

The design to be projected on the clouds is cut out of card board and this stencil is inserted in the path of the rays close to the first lens. The whole apparatus is mounted on a swivel base and trunnions so that it can be revolved and pointed in any direction and the design thus made to follow a passing cloud. The electrical features have been worked out by Mr. Elmer E. Sperry. The lamp employed takes a current of over 150 amperes and its beam is said to rival in intensity that of any search light thus far used. All that Mr. Rogers needs to do is to wait till the clouds roll by. Should they refuse to roll, however, he can create his own clouds by steam, smoke bombs in the air, etc.

THE NIAGARA FALLS ELECTRIC POWER PLANT.

The paper of Prof. Forbes, concluded in our last issue sets forth the electrical details which will be adopted at Niagara Falls in the great power transmission plant now in course of construction, and supplementing this we give below further details regarding the hydraulic arrangements and methods of conduit wire distribution.



FIGS. 1, 2 AND 3.

The units in the 50,000 h. p. station now being erected by the Niagara Falls Power Co. consist of 5,000 h. p. Westinghouse alternating dynamos, each with its revolving field directly connected to the vertical shaft of a 5,000 h. p. twin turbine, built by the I. P. Morris Co., of Philadelphia, from designs furnished by the Swiss firm of Faesch & Piccard, and shown in Figs. 1 and 2 of the accompanying illustrations, for which we are indebted to our excellent contemporary *Power*. They are of the Fourneyron or Boyden type, designed to develop 5,000 h. p. under about 140 feet head and at 250 revolutions per minute, and are made of cast bronze of the same quality as that used for the propellers of steamships.

The main canal, on the west side of which the power station is located, is 188 feet wide, and 17 feet deep at the river, narrowing to 116 feet in width, but preserving the same depth throughout its length of 1,260 feet. The water will be carried in the canal to a depth of about 12 feet. The sides of the canal are built of solid masonry, seven feet thick at the bottom, tapering to three feet thick at the top, on which is a coping two feet and a half wide. From this canal the water is taken through a separate inlet for each wheel, and carried through a penstock seven feet in diameter into the centre of the turbine. The weight of the vertical shaft and the attached portions of the dynamo, amounting to about 152,000 pounds, is taken care of by closing the bottom of the casing so that the water cannot act downward upon any of the parts attached to the shaft, while in the upper end of the casing are apertures through which the water can act upon the under side of the disc carrying the movable blades of the upper turbine and relieve the bearings of the weight of the shaft. In this way the weight of the water column is sustained by the stationary portions, and the pressure due to the head made to act upward for supporting the weight of the revolving shaft, which is thus nearly in the condition of a shaft spinning upon the water. The area involved is so proportioned that when the wheels are lightly loaded the upward pressure will be some 2,000 pounds in excess of the weight

of the shaft, and when the wheels are running at full gate about the same amount less than the weight of the shaft, on account of the lesser pressure in the casing. This variation in pressure and direction is taken care of by a thrust bearing shown in section in Fig. 3.

The shaft consists of a steel shell about a foot in diameter, with smaller solid portions for the journals.

The dynamos are constructed upon the Tesla two-phase alternating current system, with stationary armature and revolving fields, and are designed to generate a potential of 2,000 to 2,400 volts, which will be increased or diminished by step-up or step-down transformers for transmission or local use. Motor generators will be run for the production of continuous current when required, so that the station will be able to furnish continuous or alternating current of any potential. Two-phase Tesla motors will be used. The station is designed eventually to comprise ten of these units and the wheel pit and building will be extended toward the river and new wheels put in as required.

The power house is being built of stone, with a steel frame, and lined with enameled brick. The steel roof trusses of over 60 feet span rest upon steel posts, and a 50-ton traveling crane commands the entire floor.

The distribution will be through underground conduits extending in various directions from the station in the principal points of service. Fig. 4 shows the construction of one of these, while Figs. 5 and 6 are sectional views in outline. The conduit is 5 feet 6 inches high by 3 feet 10 inches wide inside, and is built with 12 inches of Portland cement and gravel, and backed up by about one foot of masonry at the bottom and extending up the sides about 3 feet. The conductors will be carried on insulated brackets on both sides. A track extends throughout the length of the conduit, upon which an electrically propelled car will carry the linemen between wire screens that protect them from the conductors and allow every portion of the line, brightly illuminated by the passing car, to be thoroughly inspected with absolute safety. The brackets are placed 30 feet apart.

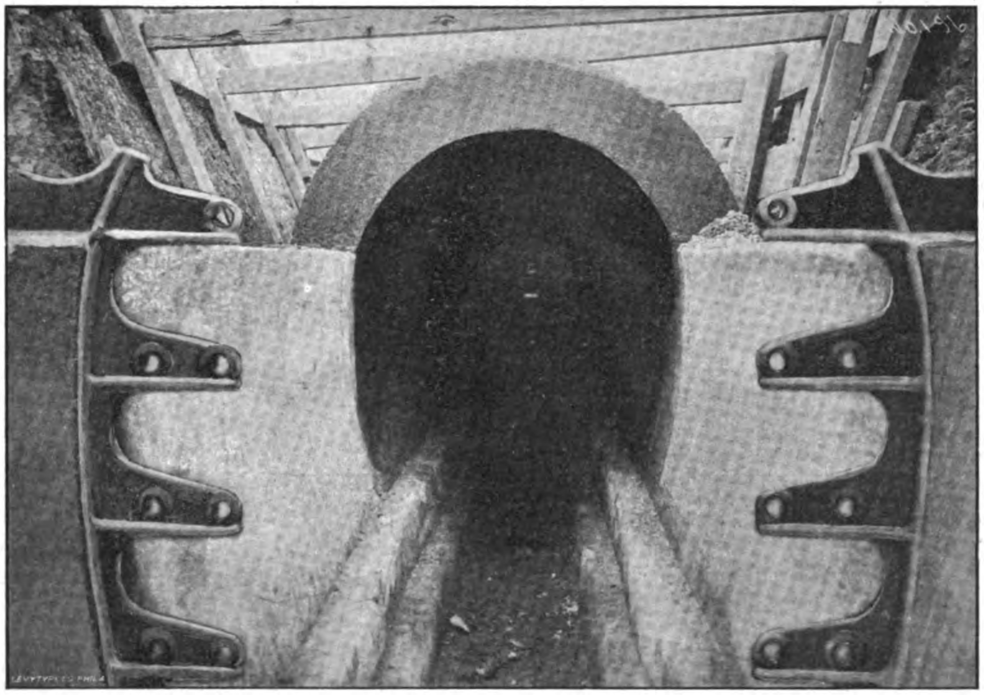
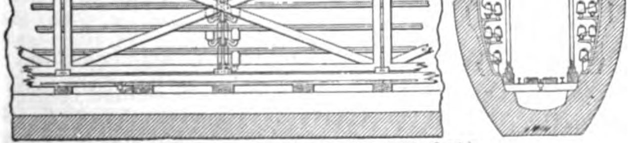


FIG. 4.—THE CONDUIT IN COURSE OF CONSTRUCTION.



Longitudinal and Cross-Section of Electric Wire Conduit.

FIGS. 5 AND 6.

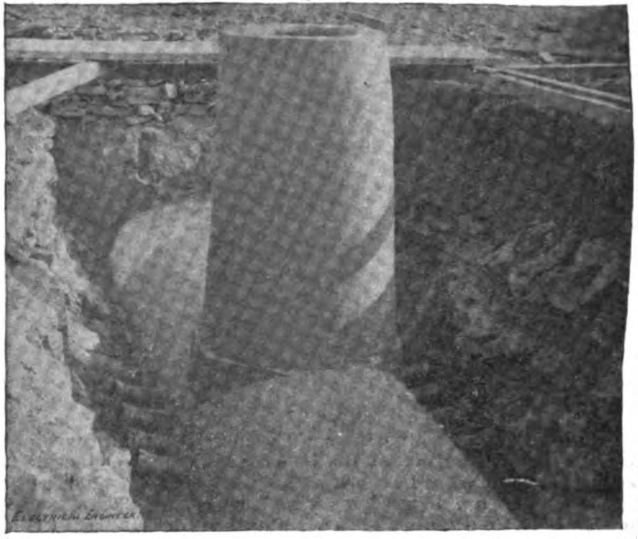


FIG. 7.—MANHOLE AND SIDE DUCTS, NIAGARA POWER DISTRIBUTION.

Fig. 7 shows one of the manholes which are placed at intervals of 400 feet. At the bottom will be seen the small outlets for tapping the conductors in the conduit.

The Niagara Falls Paper Co. have already arranged to take 3,000 h. p., and the Pittsburg Reduction Co., about the same amount for manufacturing purposes and lighting.

THE NIAGARA TRANSMISSION PLANT.

THE following is a special dispatch from Buffalo:

The real estate men of this city are considering plans for celebrating on a royal scale the inauguration of the use of the Niagara Falls electric power in Buffalo. The plan most favored is to issue letters of invitation to President Cleveland and his Cabinet, Senators and Congressmen, Governors of States, and other high officials, all the eminent electricians of the world, and representatives of the press from everywhere. The wire conveying the current is to be connected with one of the large manufacturing plants near the city line and the machinery set in motion by the touching of a button.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC CHAIN TRACTION FOR CANALS.

BY

Jules Neher

Among the notable questions of the hour is the improvement in the method of propulsion on the Erie canal. Various schemes have been brought forward having for their object the replacing of the "wave generating, bank destroying" propeller. The purpose of these lines is to discuss a system described in The Electrical Engineer a few weeks ago and to suggest a scheme that has done good work in other countries.

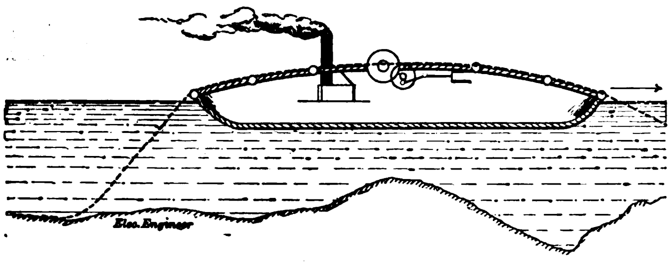
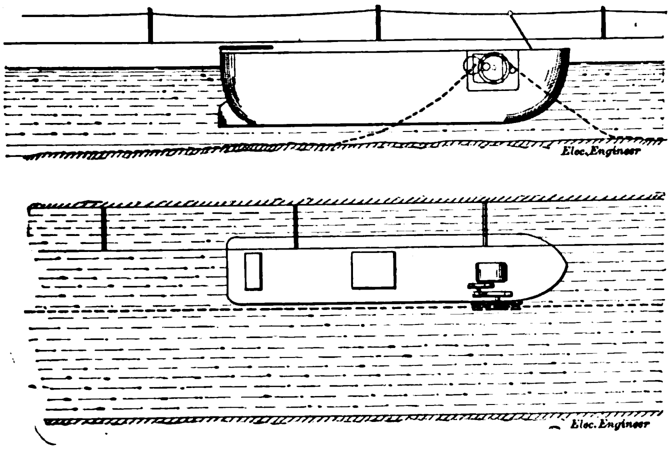


Fig. 1.

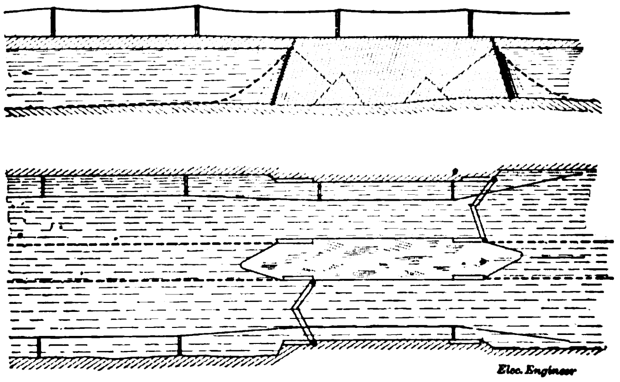
The cheapest and simplest equipment naturally is the propeller used either in connection with steam engines, or, better, driven by electric motors. The serious objection against this system is its action on the water and subsequently on the banks of the water way. A very ingenious and interesting method to overcome this difficulty has been described in the issue of The Electrical Engineer, December 20, 1893, as the "Davis' Electric Canal Boat Towing System."

The objection against this system—an objection which will undoubtedly make it prohibitive—is the enormous cost; because, if you have a canal you do not want two railroad tracks, hauling locomotives and boats. If you want to build on land a double track road is cheaper than two single tracks, and rolling traffic is cheaper than floating. Naturally we have to consider that one boat will carry the load of a whole train but a train will run about ten times as fast as a boat. As soon as we would have track construction and rolling material and canal maintenance then all the advantages of this slow transportation of large quantities will fall out of consideration when compared with the quick transport of small quantities on land either by steam or by electricity.



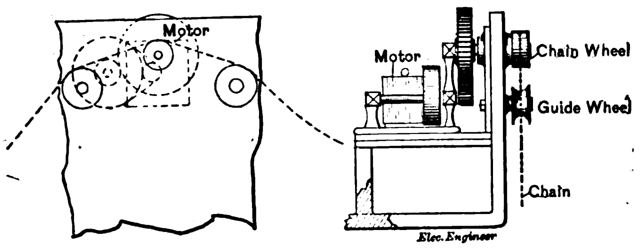
Figs. 2 and 3.

On a number of rivers in Europe, for instance the Seine in France or the Main in Germany, another system has been employed very successfully for many years, namely, chain traction. We might call this a method of cable traction with stationary cable, the boat pulling itself forward along the cable by means of a hoisting or hauling device. In the cases mentioned this towing device is located in the centre of the boat, the chain is taken up in front, runs over the hoist drum and leaves the boat at its end. The accompanying diagram, Fig. 1, will explain the arrangement.



Figs. 4 and 5.

On the Erie canal it will probably prove to be more economical to provide a number of boats with the electric equipment, than to use only a few electric tugs towing a whole train of freight boats, and this system would make necessary an arrangement that can easily be mounted in the canal boats as they exist to-day. Therefore it would be advisable to have the towing device at the side of the boat and this idea is shown in Figs. 2 to 7. The vertical iron bed plate could be mounted inside of the boat and secured to several points aft by wrought iron tension bars, which would distribute the side pull symmetrically with the axis of the boat. Motor and gearing could easily be mounted inside of the boat without taking up much valuable space. From lock to lock the chain would have to be anchored at about the height of the chain wheel, so that the boat coming towards the lock can easily run off the chain and in leaving the lock take it up again, about in the same way that cable cars do when going off from one cable section to another one.



Figs. 6 and 7.

Possibly the chain could be used as an electrical return circuit, thus saving half the amount of copper in the overhead-trolley line; and particularly there could be no objection against a ground-return, if we replace the chain by a wire-cable; in this case a friction-wheel device, that is to say, a revolving grip, would do the same service as the chain-wheel.

It seems to me that a system like this would be superior to a sheme necessitating a track system and towing locomotives. But commercially it could compete with the propeller system only in case this has to be discarded on account of its destructive action on the canal banks.

A NEW JERSEY ELECTRIC RAILWAY CONSOLIDATION.

The Consolidated Traction Company has secured control of all the street railway lines operated by the New Jersey Traction Company and all the stock of the latter company has been transferred to the former with the exception of one share apiece, to be held by the directors of the New Jersey Company, in legal formality, to keep the organization alive. All the leases of the New Jersey Traction Company have been ratified by the Consolidated, and the securities of leased lines are thus put on a more solid basis than ever before, while the Consolidated Traction Company becomes practically the owner of all lines in Newark, Jersey City and Elizabeth, except those of the North Hudson, in Jersey City; one line in Elizabeth, and the South Orange in Newark.

THE STETSON CONDUIT RAILWAY.[1]

BY ALBERT STETSON.

OVER a year ago I became engaged in some attempts to solve the conduit railway problem at Coney Island. This system was not a sudden idea, but had been a gradual development. For nearly two years it has been being gotten into shape, and a number of inventors have contributed their share towards its completion and success. The original idea of the box used down there, and the working of it out to its completed form belongs, I may say modestly, to me. Among those who have worked upon the details of the invention, I may mention Mr. G. T. Woods, Mr. C. S. Van Nuis, and Mr. John H. Dale; but whatever success it has attained has been due to the suggestions and inventions of Mr. John J. Green, who brought to the work the mind of the inventor and the skill of the trained mechanical and electrical engineer.

Knowing what had been done, having spent four months in the Patent Office, having examined the traction question on the whole Continent of Europe, we set to work to construct a system that should avoid the defects inherent in other devices. To strengthen their weak points, to make an all-the-year-round system, was our object. I assert with the utmost confidence that we have succeeded. We have, on three occasions, filled our conduit to the top with mud and water, burying out of sight conductors, contact boxes and all the devices.[2] Mud of the consistency of paste was used, and the report of a disinterested electrician, not known to me personally, brought there by the editor of one of our leading electrical journals, shows that the system was in no manner affected. With the shoe of the car in the mud, with boxes entirely submerged, the ordinary measuring instruments failed to show anything but the best insulation, and no disturbance of traffic would arise with 50 cars in a conduit filled with mud and water. No such condition would ever present itself in railway work, but a space of several hundred feet might get full of mud, snow or water, and the successful system must not be disturbed by such trifles. We made our mud test, not once, but three times. When the last test was made our boxes had been under the mud four days; yet it is to those boxes that Mr. Stevenson's report refers. Four days' submergence is a terribly hard test, but if the line then works perfectly, there is absolutely nothing to apprehend from an occasional filling up during a shower.

A conduit is used, similar to that of cable roads, but nothing like so large or expensive. With our improved shoe, a conduit two or three inches wide and seven inches deep will answer perfectly. In the slot of the conduit, attached to the car, runs a shoe extending nearly the length of the car.

The shoe is so supported that should the car leave the track it detaches itself immediately and remains on the top of the conduit. It cannot get caught, as the cable grip sometimes does, and drag the car along through crowded streets at a dangerous speed. The shoe is somewhat like a cigar in shape, so as not to give any sharp blow to the contact arms. The sides of the shoe are formed of conducting material, insulated from each other and perfectly flexible, so as to follow any curves. The shoe can be attached to and detached from a car in five to ten seconds. In the conduit are placed two insulated cables, a metallic return being used. This I regard as necessary to ensure perfectly safe working. These cables run into and through contact boxes placed at intervals of ten feet on each side, and arranged diagonally opposite, so that the distance between the boxes is about five feet.

The main is carried into the box and the lead and insulation removed for about two inches. On this bared cable there is placed a brass clamp with two upwardly projecting tongues. The contact-making portion of the device is a vertical rod, having, at its upper end an arm projecting into the conduit, and at its lower end a brush adapted to be brought into contact with the tongues attached to the cable. This rod and its bearings must, of course, be properly insulated from the contact box. When no car is passing, the brush is out of all electrical connection with the current conductor, but when the shoe on the car reaches the arm projecting into the conduit, it swings it to one side, bringing the brush on the rod into contact with the tongues fastened to the conductor, and the current passes to the motor on the car. As soon as the shoe on the car has passed the box, a torsion spring forces the rod back into its normal position, and that box is dead. The box is filled as far as it can be without interfering with the movement of the brush with solid paraffine, and above that with "transil oil." This makes excellent insulation. Of course the spindle, which at times becomes "alive," and its bearings, are thoroughly insulated from all parts of the box and cable. Nothing can be better than an insulated cable, covered throughout its entire length with a highly resisting material, and at the points where current is supplied to the car an insulation practically infinite.

No accident to persons or animals appears possible with this system. To avoid sparking within the box, the ends of the shoe are made of insulating material, thereby establishing mechanical contact within the box before the metallic portion comes into contact with the arm, and also holding the inside contact after the current ceases to flow to the motor. This is an important feature, for without such an arrangement the brushes would soon burn out, the oil become carbonized and the boxes useless.

Thus far I have described the box that we used at the Island, but it has long since been consigned to the usual receptacle for the rejected productions of progressive inventors. It did its work and did it well, it pointed the way to better things, and we have several forms of box, entirely obviating the defects in the first. The number of working parts has been reduced, and we now have the device brought down to its simplest form. I regret that it is not possible for me to show these improvements, but patents have not been obtained on some, and on others not yet applied for.

As a guide for future investigators, I will enumerate the best features and defects of the old box, as I understand them. 1st. Its insulation was excellent, that is, the theory of its insulation was. But oil insulation is in many cases a fraud, a deception and a snare. The best oil insulation is not so good as that of air containing 80% of moisture. Oil and water, perhaps, won't mix, but oil will attract moisture, and the two will make an emulsion that will cause the investigator much sorrow and mental anguish. Ordinary paraffin oil, even the highest grades obtainable, contains a great deal of water which, in a device like this, will cause disastrous short-circuiting. Transil oil seems the best for the purpose. At Coney Island, before we adopted transil oil, our boxes would go wrong, in spite of all we could do, and we only discovered the trouble by putting some of our oil in a bottle to settle over night, and in the morning found an abundance of water in the bottom. Solid paraffin is the only substance that we found capable of withstanding the action of paraffin oil, and it must be the refined variety, such as is sold in hard, white cakes. Its use even was discarded, for when the water would work down the spindle through our imperfect stuffing box, the solid layer formed a bed for the moisture to rest upon, and being close to our brush, it short-circuited the box. It is better to let the moisture settle to the bottom of the box out of harm's way. I don't think oil should be used on account of its insulating properties, but for keeping the working parts from rusting. 2d. Our old box was made in several parts (a mistake, remedied in our new one-piece box), the joints required planing, an expensive operation. Paraffin oil is difficult stuff to hold, going through almost everything. In the joints we used oil paper, screwed them together as tightly as possible, but the oil softened the paper and the boxes leaked. This we remedied by painting the joints with "Insullac," which withstood the oil excellently. 3d. Our stuffing box was a crude device, and did not in many cases, keep out the water; but this is a simple mechanical affair remedied in our new boxes. 4th. A torsion spring is not so good as a straight one, nor so reliable in its action. 5th. We had a short brush in our box, when a long one should be used. Flexibility and sure contact are thereby secured. 6th. It was a mistake to have the two upwardly projecting tongues; one contact is the thing, and the brush always resting against it when the shoe touches the arm. Otherwise there will be a break on reversing, the consequent "frilling" of the brushes, with carbonization of the oil. 7th. To make an oil-tight joint between the cable and the box was almost an impossibility. We taped the cable where it entered the box, but when it was tightened up there was often contact between the lead covering and the box. 8th. The box is too large. 9th. Great care must be used in selecting and laying the cable. A slight defect gives leakage; this decomposes the alkaline earths; chlorine and caustic soda are perhaps produced, and the cable eaten away. Every joint must be carefully made and carefully sealed. Some one may say that it is impossible, but I answer it is the duty of the supervising engineer to see that it is properly done. If any one thinks this cannot be done, he is not my ideal engineer, and certainly does not want to meddle with electric conduit railways. These are the defects, but we have cured them all in our new system. The excellent principle of the old box has remained untouched by long experiment, the laterally yielding arm being the only form likely to answer this purpose.

I believe that our road has solved the question of conduit traction. I have not meant in my review of other systems to be in the least unjust to other workers in the same field. I only take my stand on other well-established principles, keep strictly to the laws of nature and electricity, take our climate as it is and our streets as we find them, and I assert, without fear of successful contradiction, that any road to succeed must be laid down practically on these lines.

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[1] From a paper on "The Practicability of Electric Conduit Railways," read before the American Institute of Electrical Engineers, December 20, 1893.

[2] See THE ELECTRICAL ENGINEER, Oct. 18, 1893.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada,	per annum,	$3.00
Four or more Copies, in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies,		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

VOL. XVII. NEW YORK, JANUARY 17, 1894. No. 298.

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THE PROSPECTS OF ELECTRIC HEATING.

GRADUALLY but surely that later development, electric heating, is forging to the front and it must soon command more serious attention than has been bestowed upon it up to the present. The impression has prevailed that while for purposes requiring small amounts of heat, and especially where such heat is intermittently applied and where the temperature required is not very high,—such as in electric cooking apparatus, soldering irons, etc.,—the electric method is fairly economical and eminently convenient; but that for any extended application on a large scale and involving high temperatures, electrically generated heat is out of the question. While we have been favored with calculations on the economy of such minor, domestic applications as those above cited, no one, so far as we are aware, had undertaken to analyze the prospects of operating smelters and blast furnaces by electrically generated heat. At the first blush such a plan would indeed seem to possess scarcely any points in its favor and to be in the line of the general, foolish drift nowadays, to do everything by electricity. More especially does it seem unwise when it is taken into consideration that against the direct application of the fuel to the body to be heated, in one case, we have the unquestionably roundabout electric method involving a furnace, a boiler, a steam engine and a dynamo. But in spite of all this, is the electric blast furnace so far removed from practicability that it is not worth considering for the present, or even for the future? The conditions involved are very tersely put by Mr. I. L. Roberts, in an article which appears elsewhere in this issue and which will repay close study. Mr. Roberts has not contented himself with mere calculations, but bases his conclusions on the results of actual experiments. It is true, that they have been made on a small scale; but the very fact that they were on a small scale and yet showed such unmistakable advantages in favor of electric heating would fairly lead to the inference that with larger apparatus the gain would be still more marked. While the blast furnace itself may not be a thing of the immediate future, Mr. Roberts' experience has sufficiently demonstrated that for many other applications such as brass smelting, carbon baking and similar operations the electric furnace is well able to hold its own against the methods now used.

THE "NOVAK" LAMP NOT ENJOINED.

ALTHOUGH Judge Shipman handed down on Saturday, Jan. 6, an opinion granting the motion of the General Electric Co. for a preliminary injunction against the Waring Electric Co. for infringement of the Edison patent by the "Novak" lamp, with its bromine atmosphere, he has followed up his decision by refusing to stop the manufacture of the lamps peremptorily. The uncertainty or doubt that runs through the opinion seems to have gained upon the Judge's mind during the week, and when the case came up on Jany. 13, for settling the terms of the order, he granted a stay pending an appeal, under bonds of $10,000, to the Circuit Court of Appeals, the appeal being set down for January 23, at New York. He did this in spite of the offer of the General Co. to place itself under bonds if the injunction were issued. Judge Shipman is evidently more concerned to be fair than consistent, and does not propose summarily to block any real improvement in the art of lamp manufacture. The Waring Co. are now free to pursue for a while, undisturbed, the manufacture and sale of a lamp whose qualities are well illustrated in Prof. Robb's tests cited by the Judge; and we now have the remarkable spectacle of two concerns making incandescent lamps under the nominal restraint of bonds. We have no doubt that the Waring Co. and its agents will make the most of their opportunity.

AMERICAN BELL TELEPHONE PATENTS.

As the magneto telephone of the American Bell Telephone Company—the instrument commonly known as the "receiver"—becomes public property at the beginning of February by the running out of the patent, the interest as to the immediate future of the telephone industry is widespread. Not only do people want to know how soon they will get cheaper telephones, but manufacturers who wish to supply the market are anxious to know how far they can go legitimately and honestly. There has been a great deal of misinformation published on the subject, and much of it has been of a most mischievous tenor. The telephonic art is far from being wholly open. The American Bell Telephone Co. is strongly intrenched within patents that rise one behind the other like concentric fortifications, and it has not spent its existence in a supine and lazy enjoyment of fat profits to be reaped only for a season. But the lapse of the fundamental patents renders some things possible, in some fields that the company has neglected or chosen to disdain. With the object of indicating the limits of the *mare clausum* and the possibilities of the open sea of telephony, we have begun in this issue a series of articles that have been very carefully prepared, covering the whole ground of telephonic patents and telephonic apparatus. Where deemed important and pertinent, the language of the patent claims bearing on the situation is quoted in these articles. We shall be glad to have our readers assist us in the discussion of the subject, and will endeavor to answer any inquiries that touch vital points.

THE NEW BUCKEYE LAMP.

If Necessity is the mother of Invention then surely she has shown herself a most prolific parent in the domain of incandescent lamps. In some respects the history of the efforts to create a lamp outside of the claims of the Edison patent bear a close analogy to the similar attempts in respect to the Bell telephone, but with this difference: That while in the latter case but two essential elements were involved, namely, a magnet and a juxtaposed diaphragm, in the former the inventor has had no less than four elements upon which to ring the changes, involving (1) a vacuum, (2) an all glass receiver, (3) a carbon filament, and (4) leading-in wires. As a consequence we have had non-carbon filament lamps; "gas" lamps, that is, lamps containing a residual, inert gas; "stopper" lamps, and still others involving variations on the first three elements above enumerated. The leading-in wires, however, were employed in all the above types, and if we except the ingenious Diehl induction lamp, no attempt seems to have been made to work on this apparently indispensable feature of an incandescent lamp. The new Buckeye lamp described on another page will therefore prove of interest as showing the most recent efforts in a struggle which is probably without a parallel in the history of inventions. It is hardly to be expected that the owners of the Edison patent will permit the makers of the new Buckeye lamp to remain long in the unmolested enjoyment of the fruits of their labor and hence we look forward to lengthy arguments on the question of whether a conductor in powdered form can be construed as the equivalent, in law, of a solid wire.

LABOR, EDUCATION AND CAPITAL.

One of the most interesting and noteworthy steps taken in this city by a trade organization is that of which note was made in our columns last week, namely, the arrangements for a course of lectures to the Electrical Workers as part of the University Extension scheme. It is to be hoped that the trial may prove highly successful and useful. Labor has its duties as well as capital has, and these movements are an evidence of very high motives on the part of working men, and of ambitions than which none nobler can enter the human breast. We are certainly entering on a new period of industrial development when an old institution like Columbia College can thus work so closely with a trades union. We cannot forbear noting the report of another remarkable manifestation of the the trial of new principles, at Pittsburgh. Loans of money are being made there by the Window Glass Workers' Union to some of the employing manufacturers to enable them to tide over business troubles. It is said that money has been released from the organization's treasury amounting to tens of thousands of dollars in this manner, and that the applications of a number of employers are under consideration and will probably be granted. By this means several factories have been enabled to start that would otherwise be idle, and some have been kept in operation that might have had to stop. We can only regret that the electrical workers were not able to do as much for some of the electrical factories as their glass-making confrères have done in that line of industry.

Conduit Railways.

The contribution recently made by Mr. Albert Stetson to the proceedings of the Institute is of practical value. It not only includes a survey of what has been attempted and done in the development of conduit railways, but gives an excellent description of the work done by Mr. Stetson himself last year at Coney Island. These are bad times in which to get a capitalist to display the courage of his convictions, but it is a pity that capital could not be induced to back some such conduit railway enterprise as Mr. Stetson advocates. Then we should all know how much there is in it, and the chances are that the promoter would reap a rich reward. The conduit system would at least show up as well as the cable is now doing in New York City. The cable is a great boon, but we question whether a conduit system would have shown as many disasters and delays.

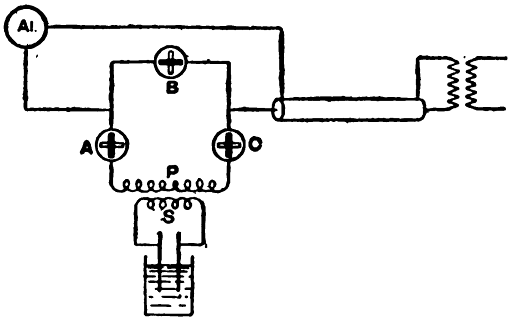
MISCELLANEOUS.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—V.

The following is an abstract of the discussion on Prof. George Forbes's Paper on "The Electrical Transmission of Power from Niagara Falls," which took place at the Institution of Electrical Engineers.

DISCUSSION.

Dr. Fleming, in opening the discussion, said it was not always that engineers were to be found who were able or willing to take them into their confidence during the constructive stage of their work, and to tell them not merely what they had done, but what they were proposing to do. He would confine his remarks to two points, and the first was the difficulties which might be expected to appear in all cases where electrical transmission of power was conducted over long lines having capacity and self-induction. These difficulties were not merely hypothetical things which were discussed by Professors, and might, therefore, be safely neglected when coming to practice, but were exceedingly real, and capable of giving rise to very disagreeable and dangerous effects. One of the great risks which had to be avoided in the construction of these lines was the presence of pressure effects, which occurred when the lines were suddenly connected to, or disconnected from, the machines. Prof. Forbes was quite right in saying that under those circumstances surgings were set up in the cables and in the machines, and that the pressure might become almost anything they pleased; it might become scores, if not many more times greater than the working pressure; in fact, it was impossible to say under some circumstances what the pressure actually did become, and under those circumstances it was of no use to say anything of failure of insulation, for no insulation would be sufficient to withstand the pressures that were brought against them. The methods by which they could be controlled had only to be known to be adopted. As Prof. Forbes had mentioned that those difficulties had been got over at Deptford, there could be no objection to his telling them the method adopted by his colleague, Mr. D'Alton, in consultation with himself and others. The way in which it was done now was this: The cable was never suddenly connected, but a transformer was placed in the main, as shown, and that transformer had on its secondary circuit an arrangement by which it could be gradually short-circuited. A water resistance was generally employed, but it might be carbon resistance. The first process of connecting the trunk main was to keep the switch B open and close A and C, the transformer being open-circuited on the secondary side. Under these circumstances the transformer offered a considerable impedance to the flow of current, and that nullified the capacity effect in the main. The next step was to gradually short-circuit the secondary circuit of the transformer, reducing the impedance of the transformer. When completely short-circuited the switch B was closed, and then the switches A and C were opened, and the transformer was disconnected from the main. In switching off exactly the reverse took place. When dealing with long concentric cables the capacity might reach a very high value—one-third of a microfarad a mile. It was almost impossible to get a cable, if it was concentric, that had not a capacity effect. If they were to adopt a pressure of 20,000 volts, and a frequency of 100, which was probably what they would have done had they started this enterprise in England, and a capacity of one-third of a microfarad with 18 miles of cable, the capacity current in that cable would be 72 amperes when nothing was connected at the other end. That could be easily calculated from the formulæ he gave some time ago. The capacity of that capacity current to do work, or rather mischief, was proportional to the square of the current and to the frequency. Hence the advantage of low frequencies, for the capacity was something enormous when they came to long lines. Concentric cables were, therefore inadmissable for long lines. He thought there was great safety in using an artificial load in putting machines into and out of parallel. In all Continental stations they did so. When he (Dr. Fleming) was at Rome last Easter he spent a long day with Prof. Mengarini at Tivoli, and the latter allowed him to experiment with the machines there as much as he pleased. They had an artificial load which took up 300 h. p., and this artificial load was made to resemble as closely as possible the real external line. The process of putting the machines in was this: First of all they put them on to the artificial line, and adjusted the incoming machines so as to give exactly the required current and volts. They then put on two machines and divided the current without any difficulty; then a third was put into parallel, and then a fourth and a fifth. They were taken out one by one by reversing the process. That artificial line was used in all the Ganz stations, and he thought Prof. Forbes was very wise in making provision for it in dealing with his machines. It was curious that they had not adopted it much in England. He did not know any place where it was used; yet at the same time he hardly knew any large alternating stations on the Continent where it was not done. In the next place he would say one word on the question of pressure. He was very glad to hear Prof. Forbes say he never intended the primary circuit to be opened. But the question naturally occurred, would not the primary circuit sometimes open itself? In other words, what was going to be done in the way of main fuses? That was really a serious question in dealing with these pressures. What kind of main fuses did Prof. Forbes intend to adopt? In his Paper he mentioned a transformer the secondary of which had a working arrangement which would gradually introduce impedance if the current rose above a certain value. He trusted that that arrangement would be found to work well; but at the present moment one great want in connection with large distributions of alternating currents was an arrangement of main fuses which would not interrupt the circuit, but if the main current went above a certain value would put impedance into the circuit gradually but quickly, and then take it out again as required, but never allowing the main circuit to be broken. The great difficulty at present was that it *did* become broken, and a great rise of pressure took place, with disastrous results to the insulation. The question of pressure was one to which Prof. Forbes and his colleagues had doubtless given very serious consideration before deciding to adopt 20,000 volts. The difficulty which might be encountered with the high pressure was not the difficulty of working with the stock pressure of 20,000 volts, but the tremendous arcs which might be produced if they were started between the conductors. Prof. Forbes did not tell them, he believed, how far apart those cables were going to be in the conduits. He described a conduit in which copper strip was to be used as the conductor, but did not mention what distance they were to be apart. That was a very important matter. It might be impossible under some circumstances to prevent such rises of pressure that an arc would start, and what would be the state of affairs with naked conductors in those conduits if they were only, say, a foot apart? The question was sometimes asked, what is the best frequency to work at? It was very much like asking, what is the best speed to walk at? It depended upon where you were going and what you wanted to do. Continental engineers had not been at work at the matter at haphazard when they adopted a frequency of between 40 and 50. Our adoption of 80 to 100 was necessitated by the circumstances under which we had to start alternate-current working; and the same in America. But there was no doubt, he thought, about the wisdom of selecting this low frequency at Niagara, where the utilization of power by motors was an important matter, and there were enormous advantages to be gained by the reduction of these capacity effects and other effects of the same kind by the employment of a reduced frequency.



Dr. Fleming's Cable Connections.

Mr. W. M. Mordey said they were called upon to discuss a Paper on a subject of world-wide importance, and he believed a sense of responsibility would be felt by all speakers. What made the Paper so interesting was that Prof. Forbes not merely described the scheme and the works, but went pretty fully into reasons and principles. It was a very important matter that after so much work had been done on alternate-current distribution of all sorts that Prof. Forbes should come there and throw the gauntlet down to the whole industry on two or three points of primary importance in connection with distribution. Those of them, for instance, who had been working at comparatively high periods had to justify their continued existence and to prove that Prof. Forbes was wrong. Prof. Forbes stated in the Paper that "it is a matter of common knowledge that parallel working is assisted by lowering the frequency." With all respect, he (Mr. Mordey) would deny that. He thought there was no evidence whatever to show, with any good plant now running, that lowering the frequency had any connection with parallel working. If there was no difficulty whatever in working at 100 periods there could be no improvement in working at a lower rate. It might be that, with certain types of machines, there were advantages in working at lower rates, but he believed that a machine that was incapable of working at 100 periods would work worse at 16 or 40 periods than a machine that would work at 100 periods successfully. The only definite argument Prof. Forbes put forward was a letter from Messrs. Ganz, who had written him "that their reason in adopting the frequency of 42 periods per second was that it is the lowest frequency that is available with arc lights so as not to produce any serious flickering, and their desire was to lower the frequency as far as practicable in order to ensure parallel working." Now, Messrs. Ganz were very important people; they had large experience all over the Continent, but it was very necessary to examine and sift statements of this sort, and not to accept them as facts. He thought they ought to ask if Messrs. Ganz had not been a little forgetful in making such a statement as that. In his Paper on alternate-current working in 1889 he made a similar statement; he quoted a letter by Mr. Zipernowski to *The Electrician* of May 10, 1889, stating that their low periodicity was "chosen on principle," "that we by this means are enabled to couple our dynamos in parallel is not a secondary result, but just the end we are aiming at." His (Mr. Mordey's) surprise was, therefore, very great when during the discussion Mr. Zipernowski wrote: "We state that we have not reduced the periodicity because of the coupling in parallel," and added that they had always kept to 85 alternations with only slight variations. He happened to know that this last statement was correct. For a considerable time before parallel working Messrs. Ganz had been making alternators of 42 periods per second; when parallel working was recognized to be a necessity they made experiments and adhered to 42 periods, and gave out that they adopted it because it gave the best results in parallel working. He was not aware of any other support than that of Messrs. Ganz to Prof. Forbes's statement, and these words taken from Mr. Zipernowski's own writing showed that his last published statement contradicted his first, and acknowledged that they had made these machines for low periods for years before parallel working was thought of. The question of artificial loading in putting machines on to mains in parallel had also been dealt with by Prof. Forbes, and had been approved very strongly by Dr. Fleming. Now, that was an old, primitive, and he thought an obsolete method. He explained a plan got out some years ago by Mr. Raworth and himself, and published in his Paper "On Testing and Working Alternators," by which the regulation of each alternator was entirely controlled by controlling the steam supplied to its engine. There was another question affecting the periodicity to which Prof. Forbes referred as probably the most important. He said: I am not sure that it ought not to be said that the greatest advantage of low frequency is in connection with the conductors used for transmission, and in the parts of the apparatus that require high insulation." Then he referred to what was strongly pointed out by Lord Kelvin, and which was found out independently by those wonderful experiments of Prof. Hughes's, namely, the surface effects in conductors at high frequency, the tendency of the current to seek the outside of conductors. That was, no doubt, in low tension alternate-current distribution, an extremely important matter. But in the case of high pressures and long distance transmission he did not think those Hughes effects, as he would call them, were by any means serious, even for the large powers Prof. Forbes proposed. In 1889 he gave a table of the virtual resistances of conductors, based on Lord Kelvin's figures. In the Niagara scheme at 20,000 volts the full current on one of the machines, with 2,000,000 watts was only 100 amperes. Prof. Forbes selected 350 amperes to the square inch as a suitable density; he thought a larger density would be more economical unless their power was going to be very costly. But taking that density from his table of Lord Kelvin's results he found that at 100 periods per second, or six times as high as Prof. Forbes intended to use his conductor, there was scarcely any Hughes effect at all. Was it worth while going down to 16 or 25 periods per second in order to get this gain? Still, keeping to the subject of low periodicity, they came to the question of transformers. He believed it was impossible by any amount of money, or space, or time, or thought, to make a transformer anything like as good at a low period as at a reasonably high one. It was not a question of design or of money. The ordinary idea that they could design a transformor to be equally good under any given set of conditions, so far as periodicity was concerned, was an entire mistake; it was not possible. If they took a transformer made for 16 periods or 40 periods, and ran it at a higher periodicity it would give a very much better result. Prof. Forbes said that by using this low periodicity he had a gain of 3 per cent. more power at his disposal at the other end, and that the transformer only cost about 50 per cent. more. But what did that mean? Prof. Forbes said a transformer would give 132 units instead of 100 if they doubled the frequency, and if the frequency was quadrupled they would get 174 instead of 100. Suppose he took it at double the output, the hysteresis and $C^2 R$ losses remained the same, therefore the proportion of the losses had doubled. He had gone down much further than he need have done. He had a triple transformation, first up from his dynamo to his mains, then from his mains down to the 2,000 volt transformers, and then down to 100 volts probably for his motors, for they were going to be worked at low voltages and with transformers. Therefore, there was a triple transformation, and at the very least a sixfold loss. What did he gain? The author supposed that he got a motor that had 3 per cent. more efficiency than if he used a high periodicity one—a supposition that had no sufficient basis. One thing he approved of, and that was the transforming up from the generator. That was very much better than attempting to generate at 20,000 volts. He did not see why they should transform up from 2,000 volts to 20,000; 2,000 was not so safe as 500 volts, and it was just as easy and cheap to transform from 500 to 20,000 as from 2,000 to 20,000. He would pass over what he had intended to say about the commutation of current, but would just say this: Prof. Forbes had, by this low periodicity, cut himself off from the possibility of using the alternate current directly. He had cut himself off from using current directly in any way except for power; he must always transform up to a higher periodicity if he was going to use his power for lighting.

LEGAL NOTES.

THE SHIPMAN DECISION IN THE "NOVAK" GAS LAMP CASE.

United States Circuit Court for the District of Connecticut. Edison Electric Light Company and Edison General Electric Company *vs.* The Waring Electric Company, *et al.*

SHIPMAN, *C. J.*—This is a motion for the preliminary injunction against the alleged infringement of the second claim of letters patent, commonly called the incandescent lamp or the filament patent No. 223,898, dated January 27, 1880, to Thomas A. Edison.

The patent has been directly and indirectly, the subject of exhaustive investigation, before the Courts of this country, and was carefully examined by the United States Circuit Court of Appeals for this Circuit in the case of the Edison Electric Light Company against the United States Electric Lighting Company. In the opinion of the Court in that case, Judge Lacombe clearly states the history and nature of the invention, which consisted, in general, in substituting carbon "reduced in size to the filamentary form and placed in a nearly perfect vacuum" for illuminants which had previously been the subject of experiments, a change of material "which involved a reorganization of the lamp" and "presented the complete combination of elements, which for the first time in the art produced a practical electric light."

The second claim is thus paraphrased by Judge Lacombe: "The combination of carbon filamentary or thread-like in size and properly carbonized, used as an illuminant in an incandescent electric lamp in a receiver made entirely of glass and conductors passing through the glass, and from which receivers the air is exhausted to such an extent that disintegration of the carbon due to the air washing action of surrounding gases or to any other cause is so far reduced as to leave the carbon practically stable."

The defendants' lamp called the Waring lamp, is the Edison lamp, with the alleged exception that in the receiver, a nearly perfect vacuum has not been created by exhaustion of the air, but that into the partially exhausted receiver a portion of bromine gas has been introduced. This introduction of bromine and the consequent lessening of the vacuum, it is claimed, produced a marked improvement in the stability of the carbon and in the diminution of the blackening of the glass of the lamp.

This improved construction is protected by letters patent to John Waring, No. 497,038, dated May 9, 1893. The specification says that the atmospheric air may be partially withdrawn by means of an air pump, and the gas is then admitted. "This gas admitted to the globes and diluted by the air remaining in them is then partially withdrawn and more gas allowed to enter, this process being repeated until the extent to which the desired gas is diluted with foreign gases has become practically infinitesimal. If preferred, the atmospheric air may be at first exhausted as nearly as possible, and the desired gas then admitted around the carbon. The amount of gas to be admitted will in practice vary with the size of the inclosing chamber, with the nature of the gas and probably also with the nature of the other elements of the lamp." This vague description of the ultimate character of the vacuum and of the amount of "desired" gas, which was to be admitted, furnished inadequate data by which to ascertain with precision the extent of the departure from the Edison lamp. The question naturally arises, how much desired gas is admitted, after the atmospheric air has been exhausted "as nearly as possible." The defendants' affidavits state the successive steps which are taken in practice and the resultant vacuum is given in a number of the affidavits with adequate accuracy.

Prof. Appleton gives the essential features of the process, as he saw it in the ordinary manufacture of the lamp, as follows: Atmospheric air was pumped from the bulb by a mechanical pump, not by a mercury pump. Bromine vapor was allowed to fill the bulb, so that the orange red color of bromine was visible therein. Then followed pumping by a mechanical pump by which "bromine vapor and air are to a large degree removed." An ample amount of bromine vapor is again allowed to fill the bulb. A third mechanical pumping follows, by which, "residual air and bromine vapor are largely removed, but some bromine vapor remains."

The lamp is sealed by fusing the glass opening. The general conclusions, taken by themselves, of Prof. Appleton and also of

Prof. Carmichael, both competent analytical chemists, whose affidavits are introduced by the defendants, would far from satisfy the mind that a material departure from the exhaustion which was the result of the Edison method of manufacture, had been sought in the Waring lamp. For example, Prof. Appleton says: "My conclusions, therefore, are that the Waring Electric Company is undoubtedly introducing bromine in their lamps in the process of manufacture, that the bromine remains in them after their entry in the market; in a given bulb, the quantity is small, but it is perfectly recognizable by the chemist and it cannot, in an electric lamp, be fairly called unworthy of consideration."

Prof Carmichael says: "The vacuum, as deduced from the experiment cited, is considerably less perfect than that of the Edison lamp. By the ordinary factory tests of observing the duration of the vibration of the carbonized filement, the Novak (Waring) lamps as supplied to me, appeared to be less perfectly exhausted than the Edison lamps, as I have ordinarily observed them in use."

Other experts upon each side of the controversy are, however, able to state with more mathematical accuracy, the exact nature of the vacuum, and they do not essentially differ in their conclusions.

The affidavit of Mr. Howell, in behalf of the complainant, after saying that all lamps exhausted to a high vacuum have residual gases remaining in them, which are "not common air but are probably a mixture of gases in which hydrogen predominates," states as follows:

"The vacuum produced in practice in the Edison lamp is about $\frac{1}{30000}$ of an atmosphere: that is, 29,999 out of 30.000 units of atmosphere are removed from the globe. Or, in other words, if we assume the height of a mercury column at atmospheric pressure to be 30 inches, such a column connected to one of these lamp globes will be depressed $\frac{1}{1000}$ of an inch, due to the pressure of the residual gas within the globe. A very much lower vacuum or high pressure than this, however, can be used in practice without destroying the commercial character of the lamp, even when no special gas is introduced into the globe. A pressure which will lower the mercury column $\frac{1}{100}$ of an inch, that is, a vacuum of $\frac{1}{3000}$ of an atmosphere would, I believe, be sufficient for commercial purposes without the use of any of the supposedly inert gases, although a higher vacuum is more desirable."

The results of Mr. Howell's tests are as follows:

"The Waring lamps contain a gas pressure which may be as high as $\frac{1}{30}$ of an inch in the case of the 16 c. p. and 25 c. p. lamps, and which runs from that pressure down to $\frac{1}{100}$ of an inch in the case of the 32 c. p. lamps and 50 c. p. lamps, * * *.

In considering the effect of even so high a pressure as $\frac{1}{30}$ of an inch, it should be borne in mind that this means a vacuum of $\frac{1}{600}$ of an atmosphere, involving the removal of 599 out of 600 parts of the air or other gases within the globe."

Mr. Thomas B. Stillman for the complainant, found that each one of the 16 c. p. Waring lamps which he tested contained a pressure of $\frac{1}{666}$ of an atmosphere, or a vacunm in which 665 out of 666 units of gas are removed.

Turning now to affidavits of the disinterested witnesses for the defendant: Professors Wright and Anthony devote themseves substantially to a statement of their opinions in regard to the improved character of the Waring lamp over that of its Edison predecessor by reason of the introduction of bromine gas which they think preserves the transparency of the walls of the lamp and the stability of the carbon. While the question of the extent of an alleged improvement upon an existing patented combination may become incidentally important in ascertaining the character of the departure from the peculiarities of the invention which were described in and protected by the patent, it is obvious that the first and vital question is, were all the elements of the patented combination used in the second and improved invention in the manner and to produce the results described in the antecedent patent. Without, therefore, attempting to ascertain the correctness of Professor Anthony's conclusions that the introduction of bromine into the chamber of an incandescent lamp is a new step in the art where results "are of the utmost importance," I shall confine myself to a consideration of the question, whether before he took the step he made use of the Edison entire combination, and whether the alleged improvement is an addition to, and not a substitute for, one of Edison's described elements.

The defendant's affidavits, which are of importance in this connection, are those of Professors Carmichael and Robb and Mr. Charles A. Stone. Professor Carmichael says that the Waring lamp contains residual gases which occupy about $\frac{1}{2000}$ of the whole volume of the lamp and the bromine vapor about $\frac{11}{10000}$ and together $\frac{1}{625}$. Mr. Stone places the exhaustion of the Waring lamp to between $\frac{1}{600}$ and $\frac{1}{1000}$ of an atmosphere.

The conclusion of Professor Robb, who, it is proper to say, has given more attention to this subject than either of the other experts for the defendant, is that the bromine gas in the Waring 16 or 25 c. p. lamp is under a pressure, when the lamp is heated, of about $\frac{1}{600}$ of an atmosphere. There is, therefore, no important disagreement between the experts on either side in regard to the vacuum in the lamps of those respective powers. The estimates vary from $\frac{1}{600}$ to $\frac{1}{666}$ of an atmosphere.

It must be observed that Mr. Howell's tests of 50 c. p. Waring lamps (not including those called Lot No. 1, which turned out to be vacuum lamps manufactured by the Perkins Company) showed a high vacuum. He thinks that the vacuum in the 50 and in the 32 c. p. Waring lamps exceeded that in those of lower power. The experiments of the defendants' experts has been limited to lamps of 16 and 25 c. p. and therefore I shall confine myself to the results which flowed from these experiments and which, of course, I assume to be true.

The defendants' legal position is authoratively stated in Seymour vs. Osborne, 11, Wall, 516, as follows:

"Inventors of a combination * * * * * * cannot suppress subsequent improvement which are substantially different, whether the new improvement consists in a new combination of the same ingredients or of a substitution of some newly discovered ingredient or of some old one performing some new function not known at the date of the letters patent as a proper substitute for the ingredient withdrawn from the combination constituting their invention." Their theory is that the instroduction of bromine gas into a globe only partially exhausted is a substitution of a newly discovered ingredient for the air exhaustion of the Edison patent.

What Waring puts into the receiver is not of prime importance, but the question to be solved is whether he exhausts the contents of the globe, whether air, residual gases, or newly introduced bromine gas to such an extent that when the glass is sealed, he has used that part of Edison's combination to such an extent that thereby the carbon is rendered practically stable. The mere introduction of gases into the receiver is not important, but if, before they had been introduced, Waring takes away the atmospheric air and the residual gases and, after the new addition has been introduced, he takes away the contents of the globe by exhaustion, so that a practical vacuum finally remains, not as high as Edison thought necessary, for the spongy and porous cotton thread which he carbonized, but a vacuum which renders practically stable a carbon, filamentary in size and of whatever hard and dense material it may be composed, then Waring has taken the combination of Edison, however much he may have improved it by the residual of bromine gas which Prof. Carmichael estimates to occupy $\frac{11}{10000}$ of the volume of the lamp.

To ascertain the effect of the exhaustion by the Waring method upon the stability of the carbon, it is necessary to look at the result of Prof. Robb's instructive experiments, which were as follows:

Four Perkins, 25 c. p. lamps and four Edison 16 c. p. lamps were taken to the Waring factory. Two Perkins lamps (Nos. 1 and 2) and two Edison lamps (Nos. 1 and 2) were left unaltered. The remaining lamps (Perkins Nos. 3 and 4 and Edison Nos. 3 and 4) were opened and partially exhausted and treated with bromine as if they were Waring lamps in the ordinary course of manufacture. The voltage required to raise the lamps to their normal c. p. was measured.

Perkins	lamps	No.	1	(original lamp)	gave	25	c. p.	at	47.7	volts.
“	“	“	2	(“ “)	“	25	“	“	48.0	“
“	“	“	3	(bromine “)	“	25	“	“	50.9	“
“	“	“	4	(“ “)	“	25	“	“	49.5	“
Edison	“	“	1	(original “)	“	16	“	“	56.3	“
“	“	“	2	(“ “)	“	16	“	“	54.0	“
“	“	“	3	(bromine “)	“	16	“	“	59 0	“
“	“	“	4	(“ “)	“	16	“	“	59.5	“

The four Perkins lamps were then run at 65 volts for 10 hours and 75 volts for four hours. The Edison lamps were run 8 hours at an average of 78 volts. The c. p. of the lamps was then measured at the same voltages as those at which the preceding remeasurements had been made, and it was found that:

Perkins	lamp	No.	1	(original lamp)	gave	13.6 c. p.
“	“	“	2	(“ “)	“	13.8 “
“	“	“	3	(bromine “)	“	23.0 “
“	“	“	4	(“ “)	“	Candle power could not be measured as filament broke a few minutes before run ended.
Edison	lamp	No.	1	(original lamp)	“	6.1 c. p.
“	“	“	2	(“ “)	“	4.4 “
“	“	“	3	(bromine “)	“	9.9 “
“	“	“	4	(“ “)	“	11.0 “

The second test was as follows:

"I took four lamps in the course of construction at the Waring Electric Company's factory and had them exhausted on the pump at the same time. Two of these lamps (Waring lamps Nos. 1 and 2) were filled with bromine and two (Waring lamps Nos. 3 and 4) with air, the degree of exhaustion being identical in all four lamps. The filaments in these lamps were intended for 16 c. p. lamps and the voltage at which the lamps would yield 16 c. p. was measured at the Physical laboratory of Trinity College, and it was found that:

Waring	lamp	No.	1	(Bromine lamp)	gave	16	c. p.	at	118.0	volts.
“	“	“	2	(“ “)	“	16	“	“	115.0	“
“	“	“	3	(Air “)	“	16	“	“	128.9	“
“	“	“	4	(“ “)	“	16	“	“	126.9	“

The lamps were then run at 115 volts for 20 hours. The candle power of the lamps was then remeasured at the same voltages as those at which the preceding measurements had been made, and it was found that:

Waring	lamp	No.	1	(Bromine lamp)	gave	16	c. p.
“	“	“	2	(“ “)	“	16	“
“	“	“	3	(Air “)	“	9.4	“
“	“	“	4	(“ “)	“	11.0	“

These and kindred tests satisfy Prof. Robb that the vacuum in the bromine lamps is so poor that if the vapor in the lamps had been air instead of bromine they would have been considered worthless.

In view of the present condition of incandescent lighting in this country, I have no doubt that an Edison lamp with the exhaustion which was given in the experiments would be considerd by the users of electric light as so far inferior to the ordinary standard of an Edison lamp as to be worthless, and would be discarded by those who were accustomed to the usual stability of an incandescent lamp. But the experiments show to my mind, when read in connection with the other affidavits of the defendants, that Waring intentionally used the principle of exhaustion to a generous degree and that the vacuum ingredient of Edison, was, to a large extent, employed and its benefits were partially enjoyed. Waring took the lamp which Edison gave us in 1880 and which was the first practical incandescent electric light and used the idea of exhaustion to a more limited extent than the original inventor thought was necessary; nevertheless, without the large exhaustion of the atmospheric air and the gases which Waring accomplished, his lamp would be a failure.

It will not be claimed that the inventor of an improvement upon a previously patented combination can use one of the patented elements in a dwarfed and incomplete way, but by its use receive the old resultant benefit, and escape the charge of infringement by reason of the low percentage of such use. The defendants' theory is that its use is so far unlike that of Edison that it can properly be said to be radically different. That theory is not supported in the Waring specification and it does not seem to me to be supported by the facts. The statement in the specification that the atmospheric air may be at first exhausted as nearly as possible and the desired gas then admitted is significant. Professors Appleton and Carmichael's affidavits show that the amount of gas which finally remains in the lamp globe is small.

The defendants claim that the Edison patent which was dated January 27, 1880, has expired by reason of the expiration of the British patent No. 4576 for the same invention antedated to November 10, 1879, but not sealed and the specification of which was not enrolled until after the United States patent in suit had been issued.

This question was recently examined by Judge Jenkins in the American Bell Telephone Company vs. Cushman, 57 Fed. Rep. 842, He refers to the various decisions upon the question and concludes that "the invention is not patented abroad before the actual sealing and issuance of the patent," and that the term "patented" as used in section 4887 of the Revised Statutes, does not mean the preliminary proceedings but the actual issuance of the patent under the seal of the Government speaking the exercise of sovereign will, investing the patentee with a grant of a monopoly. In this conclusion I entirely concur.

The motion is granted. The terms of the order are to be settled upon notice.

C. A. Seward, F. P. Fish and R. N. Dyer, for the complainants.
Chas. E. Perkins and W. E. Simonds, for the defendants.

Our New England editor writes :—

Another hearing was had before Judge Shipman on Saturday, January 13, when the Judge granted a stay of injunction pending an appeal to higher courts, under bonds of $10,000. The Judge entertained a grave doubt as to whether his opinion already rendered was a just one as it brought up a number of new features in the art of incandescent lamp making. The General Company offered to go under bonds themselves if the injunction were granted, but the court declined to accede to the proposition. It is understood that under this action of the court, the Waring Co. will have at least another month free from all trouble before the case can come up again. They were proceeding with the manufacture of the lamp as usual last week.

PROF. ROWLAND vs. THE CATARACT CONSTRUCTION CO.

Suit has been brought against the Cataract Construction Co., by Prof. Henry A. Rowland, of Baltimore, for $30,000, claimed as the value for services rendered in connection with the electric power transmission at Niagara. It appears that after the plans of the engineers of the Cataract Co., had been formulated they were submitted to Prof. Rowland for his opinion as to their feasibility and after a careful study he submitted an opinion embodying improvements differing widely in character from the methods and designs indicated in the original plans. For this opinion Prof. Rowland presented a bill of $10,000 to the company, which was considered excessive and which was only honored to the extent of $3,500. Hence the suit.

Prof. Rowland claims that practically all of his suggestions were adopted by the Cataract Co., and that by so doing they saved a large amount of money ; and hence he considers his charges no greater than the magnitude and importance of the work warranted him in making them.

The case was to have come up for hearing last week but was postponed owing to the crowded condition of the Court calendar. A number of eminent electrical engineers will appear on both sides and it is believed that some interesting details relating to the Niagara project will be brought out during the trial.

INJUNCTION AGAINST THE DE KHOTINSKY LAMP.

Circuit Court of the United States, District of Massachusetts. In Equity. No. 3,211. The Edison Electric Light Company, *et al.*, *vs.* Achilles de Khotinsky, *et al.*—Opinion of the Court (filed Jan. 9, 1894).

Colt, *J.*—The defendants do not disclose by their affidavits the kind or amount of vapor which is inserted in the glass bulb of their lamp. From all that appears therefore the defendant's lamp has the vacuum called for by the Edison patent, although it may contain in addition a small amount of some kind of gas or vapor.

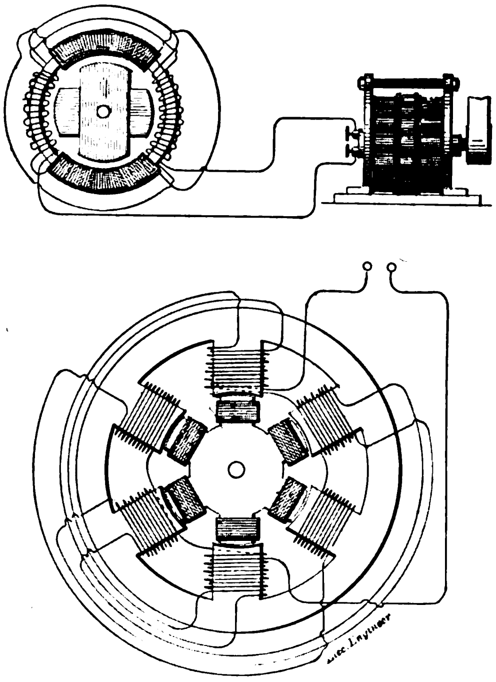
Under the circumstances it would be improper for the Court to enter further into the consideration of the questions sought to be raised by this motion.

As the proof stands, I am of opinion that the defendant's lamp contains all the elements set forth in the second claim of the Edison patent. *Motion granted.*

PATENT NOTES.

TESLA SINGLE CIRCUIT ALTERNATING MOTOR.

In a patent issued to Mr. Nikola Tesla, on Jan. 2, entitled "Electrical Transmission of Power," No. 311,915 originally filed May 15, 1888, that inventor describes a method of operating motors from a two-wire alternating circuit. The method employed is set forth in the two claims of the patent which we give below :



Tesla Single Circuit Alternating Motor.

1. The method of operating electro-magnetic motors having independent energizing circuits, as herein described, which consists in passing an alternating current through one of the energizing circuits and inducing by such current the current in the other energizing circuit of the motor, as set forth.
2. The method of operating electro-magnetic motors having independent energizing circuits as herein described, which consists in developing an alternating current in one of said energizing circuits and inducing thereby currents in the other energizing circuit or circuits, as herein set forth.

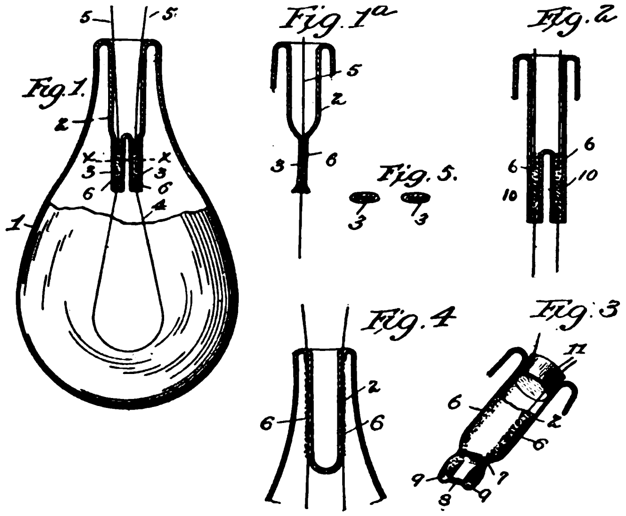
THE NEW BUCKEYE LAMP WITHOUT LEADING-IN WIRES.

Since the decision sustaining the Edison lamp patent was rendered, numerous forms of lamps have been produced embodying features claimed to be outside of that patent. The principal claim of the Edison patent it, will be remembered, is what is known as a "combination" claim, involving the elements of an all-glass receiver, a carbon filament, a vacuum and leading-in wires. A lamp, therefore, embodying all but one of these elements would not come under the claims of the patent and as a result we have lamps made with the glass in two parts, like the Westinghouse stopper lamp, or the Beacon with a composition stem through which the leading-in wires pass, etc.; while others again have been made with filaments claimed to contain no carbon.

In all these lamps, however, leading-in wires have been used; but even this element, it would seem, is capable of evasion or abolition as exemplified in the new Buckeye lamp, noted by us last week and just brought out by the Buckeye Electric Co., of Cleveland, Ohio. This new lamp is based on a patent issued to the late Edward Pollard, of Cambridge, Mass., entitled "Incandescent Electric Lamp," No. 485,478, issued March 2, 1892 from which we reproduce the accompanying illustrations. Fig. 1 shows a vertical section of a lamp and Figs. 1a the details of the stem holding the filament; while Fig. 5 is a section on the line *x x*.

The leading-in wires in this lamp are replaced by a conductor formed by depositing upon glass a line of silver or other metal in powdered form and then heating the glass sufficiently to cause the metal to adhere to it. The line of minute particles thus embedded in the surface of the glass forms a conductor for the electric current. In embodying this principle in a lamp, as shown in Fig. 1, the interior surface of the tubes 3 3 is coated with sizing, and upon this sizing there is sprinkled fine silver powder, after which the tubes are heated sufficiently to cause the particles of silver to adhere firmly to the glass, the sizing serving to hold the powder in position upon the glass until the glass is raised to the temperature necessary to cause the powder to adhere thereto. While the glass is hot the stem is pinched until its opposite walls come in contact and become welded together, Fig. 1a, thus forming a seal. The ends of the carbon filament are attached within the ends of the glass tubes by carbon paste. The conducting-wires 5 5 are connected by cold-pinching them within the tubes 3 3, having the wire in contact with the silver, as shown in Fig. 1. The silver particles thus united with the glass form a conducting connection between the conducting-wires and the carbon filament.

According to the inventor the best method of obtaining the silver in powdered form is to dissolve the silver in nitric acid and then suspend pieces of copper in the solution to cast down the silver in a very fine powder. The silver is then thoroughly washed and passed through a fine sieve. The sizing used to attach the powder to the glass is made by mixing together copaiba balsam (two parts) and fir balsam (one part.)



THE NEW BUCKEYE LAMP.

Figs. 2, 3 and 4 show various modifications of the method of applying the conducting powder to the stem. The process has since been further refined and perfected.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—DR. LOUIS BELL ON POLYPHASE APPARATUS.

THE eighty-third meeting of the Institute promises to be very interesting. It will be held at headquarters, 12 West Thirty-first street, New York City, to-day, Wednesday, January 17, at 8 o'clock p. m.

A paper will be presented by Louis Bell, Ph. D., of Boston, on "Practical Properties of Polyphase Apparatus."

By direction of Council, the last report of the Committee on Units and Standards will be presented for discussion, in which is proposed the provisional adoption of the terms "gilbert," "weber," "oersted" and "gauss." The full report will be found on page 662 of the December Transactions.

The January issue of the Transactions will not be published until after the next meeting.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

MR. C. O. BAKER, JR., master of transportation, writes us as follows:

The Trunk Line Association have granted the rate of a fare and a third on the certificate plan to Washington and return during the period of the Convention, namely, February 27, 28, March 1. The various other passenger associations have the matter under advisement, and will, in all probability, render their decision in the near future.

MONTREAL ELECTRIC CLUB.

WE have received the constitution and bylaws of the Montreal Electric Club, whose useful object is to promote the knowledge of electrical science. It has members and associate members, with appropriate qualifications for each class.

PERSONAL.

MR. JOHN PRICE JACKSON is now in charge of the Department of Electrical Engineering at the Pennsylvania State College as Assistant Professor of Electrical Engineering.

MR. GEORGE E. BADGER has resigned his position at the Edison General Company's works, Schenectady, N. Y., and has left that city to assume the management of Mr. Edison's mining machinery interests in New Jersey. Mr. Badger has been prominently identified with the Edison factory, having been night general superintendent for several years.

WEMPLE-POPE.—The marriage is announced for January 23, at Elizabeth, N. J., of Miss Nellie Lowrey Pope, daughter of Mr. R. W. Pope, secretary of the American Institute of Electrical Engineers, to Mr. Horace Russ Wemple. Miss Pope has been of much service to the Institute in recent years, in assisting her father upon state occasions, and may well be looked upon as the "daughter of the regiment." All its members will wish for her a very happy and prosperous married life.

OBITUARY.

WILLIAM RICHARDSON.

MR. WILLIAM RICHARDSON, so long president of the Atlantic Avenue Railroad, Brooklyn, and who died of heart failure in that city on December 31, was born in Berkhampstead, England, on December 8, 1822. When twelve years of age he went with his father to Gambier, Ohio, where he obtained a position in a newspaper office. In 1840 he removed to Albany where he remained for twenty-five years interesting himself in city affairs and later joining the editorial staff of the Albany *Evening Journal*. At the outbreak of the war he was appointed a paymaster in the Army, and at its close became superintendent of the Dry Dock, East Broadway and Battery Railroad Company. Within a few weeks he became one of the directors and shortly afterward was elected president of the road, which office he resigned in 1867 and became sole lessee and proprietor of the Brooklyn and Jamaica Railroad Company. He served on the Brooklyn Board of Aldermen for two years—1870 and 72—and was a member of the first Republican State Committee. He was a Freemason, an Odd Fellow and a member of several other civic organizations and was prominently identified with the Baptist Church. Of late years, despite early prejudices against electric traction, he showed great interest in electric railways, and his death finds Brooklyn one of the foremost cities in the Union in the adoption of electricity on its street railways, the Richardson roads now being fully equipped.

No one will be more missed at the meetings of the American Street Railway Association than the white-haired, witty, incisive Deacon, with his strikingly English way of hanging on to a thing till he had found out or fought out all there was in it worthy a struggle. His son has long been the efficient secretary of the Association.

REPORTS OF COMPANIES.

REPORT OF THE STANDARD UNDERGROUND CABLE CO.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburgh, have declared the usual quarterly dividend of 1½ per cent. During the year the company secured new orders amounting to $628,000. At the beginning of the year unfilled orders amounting to $100,000 remained on hand, which makes the approximate business for the year $725,000 gross. For the first 11 months of the year the net earnings amounted to $118,735, and it is estimated that with December's earnings the company will show net returns of at least $130,000, which is over 12 per cent. on the capital stock. The net earnings of 1892 were $93,000, showing an increase during 1893 of about $40,000. The company have most of their departments running day and night throughout the year, and begin the new year with enough orders on hand to run day and night until May 1.

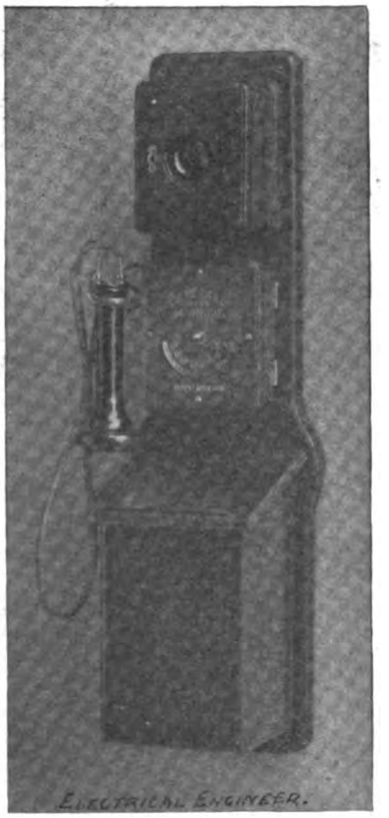
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE NESS AUTOMATIC WAREHOUSE TELEPHONE.

A NEW warehouse telephone has just been introduced by the well-known telephone and electrical manufacturing firm, T. W. Ness & Co., of Montreal. The special feature of this new instrument, which is the invention of Mr. T. W. Ness, and has been patented in Canada, the United States and other countries, is an automatic switch return by means of which the switch is brought back automatically to its normal point after conversation is finished. Those who are familiar with the old systems, in which connection is made by inserting a plug in a socket corresponding with the line desired, which plug requires to be withdrawn after through talking, but is constantly overlooked, or the old style of switch, which requires to be returned by hand to its normal point, will at once see, and appreciate the great value of this new and unique invention.

The style of instrument is shown in the accompanying engraving.



NESS AUTOMATIC WAREHOUSE TELEPHONE.

The automatic switch, receiver hook and bell, are combined in the centre box. This system is particularly suitable for connecting the different departments of factories, warehouses, offices, banks, colleges, etc. It will be observed that no central office for making the different connections is required; each instrument in a series has switchpoints corresponding or connecting with each of the other instruments. Thus any one telephone can call up any other, simply by turning the switch lever around to the point corresponding with the instrument desired, and at the same time ringing up, which is done by pressing the lever down upon the outer-ring, shown below the switchpoints; this causes the bell of the required instrument to ring. After conversation is finished, the hanging up of the receiver causes the switch lever to return automatically to its own point, thus leaving the telephone in position to be called up by any other instrument. When desired, the instruments can be so arranged that only certain ones in a series can call up certain others, instead of having the whole system interchangeable. In ringing up, only the bell of the instrument required sounds, so that none of the others is disturbed; and conversation is at the same time private. In a series of, say, eight instruments, 1 and 3, 2 and 4, 5 and 6, might converse at the same time without interfering with one another.

The firm of T. W. Ness & Co. have been manufacturing main line and warehouse telephones for a number of years. The large number of testimonial letters submitted from leading business houses, speaks well for the satisfaction their instruments are giving.

It is understood that the firm contemplate establishing a branch in this country for the manufacture of their various lines of telephones.

THE NEW NATIONAL ELECTRIC COMPANY.

The management of the new National Electric Co. of Eau Claire, Wis., comprises A. L. Ide, president; Peter Truax, vice president; F. P. Ide, secretary and W. A. Rust, treasurer. While adhering strictly to the National type of apparatus, the company proposes to introduce all improvements suggested or rendered necessary by the advance of the art. The various designs have been scrutinized and modified wherever desirable, and the factory equipment has been revised and enlarged, so as to turn out good work with increased facility. The selling department has been thoroughly reorganized. Messrs. F. W. Horne and John L. Martin, late of the Chicago office of the General Electric Co. have taken the general selling agency of National apparatus in the United States, with headquarters at 505 Home Insurance Building, Chicago. Local agencies are now being actively started all over the country. The alternating dynamos and transformers are in all sizes and are accompanied by fine station equipment and switchboard details. In direct current, there is a large line of bipolar dynamos and motors, and the multipolar units run up as high as 250 h. p.

It may be added that while the company is under Mr. A. L. Ide's able and vigorous management, it is, and will be kept, entirely distinct from the Ide Engine Co. of Springfield Ill. The National Electric Co. invite correspondence.

ELECTRIC APPLIANCE COMPANY.

THE ELECTRIC APPLIANCE COMPANY report great progress with the Packard transformer. Two orders of nearly one thousand lights capacity each is the record for the past week in addition to numerous smaller orders in the past few weeks aggregating over one thousand lights. Reports from customers show a very high efficiency coupled with close regulation and general satisfactory results.

THE ANSONIA ELECTRIC CO.'S OFFER.

AFTER careful consideration, the directors of the Ansonia Electric Co, have withdrawn their offer of 60 cents on the dollar, in long notes, the reason given being that the proposition was not generally availed of, and that the business in Chicago is now pretty badly disorganized. Another offer will be made, of lower amount, but probably on a cash basis.

IDEAL OIL FILTERS.

THE hard times of the past year seem to have benefitted at least one concern. The Purity Oil Filter Co. of Pittsburgh say they have found manufacturers willing to investigate appliances which, though involving some initial expense, were very economical in the long run; and to this fact they attribute the great number of recent sales. The circular of Pacific Coast testimonials issued by the Company speaks in highest terms of the Ideal oil filter. Not the least testimonial is the only eastern one in the lot, speaking of comparative tests, in which the "Ideal" was proven the superior.

THE CARD ELECTRIC MOTOR AND DYNAMO COMPANY.

THIS company has just moved into its new factory at the corner of Broadway and Hunt street, Cincinnati, Ohio. The building is one of the handsomest structures devoted to manufacturing in the United States; while the arrangement of general offices, especially with reference to all modern interior conveniences, etc., is simply ideal. There is no counter-shafting or belting used in connection with any machinery in the factory, each lathe, drill, etc., being run by its own motor. One of the front rooms is being fitted up as a show-room, in which may be seen the different types of apparatus manufactured by the Card Company. Messrs. Wilshire and Bullard are to be congratulated upon their new factory and upon the successful business which has made it possible.

MR. A. LANGSTAFF JOHNSTON C. E., E. E., has been awarded by the Franklin Institute the Edward Longstreth medal of merit for his safety disconnector for electric railway trolley circuits. The device has been described and illustrated in THE ELECTRICAL ENGINEER.

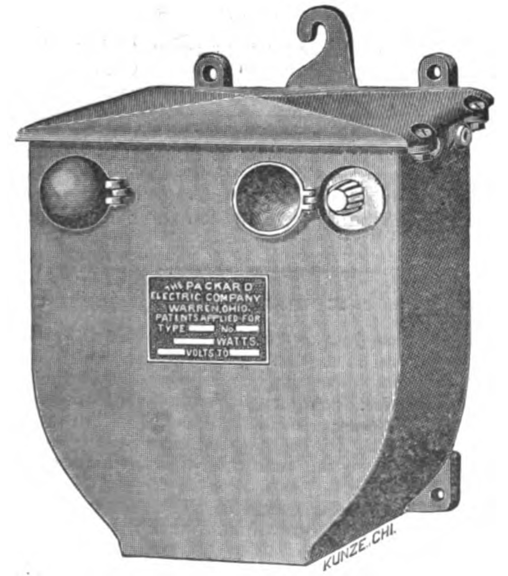
THE PACKARD TRANSFORMER.

The improvement of the past few years in transformer construction has probably been more marked than in any other class of electrical appliances. In the Packard transformer which is shown in the accompanying illustration, an attempt has been made to incorporate all of the improvements of the past few years in transformer construction, and at the same time to avoid the mistakes which have naturally been made in many cases in attempting to secure desirable but hitherto unattained results. The innovation of the oil transformer was one of the many attempted improvements and while it has its advantages there are also many objections to its use. Perhaps the most radical change has been in the construction of transformers with removable coils. While these have not been on the market for any great length of time it is becoming pretty clearly demonstrated that the convenience of being able to readily replace burned out coils is secured at altogether too great a sacrifice in efficiency and regulation. The tendency of improvement should be to perfect first construction, not to make provision for defects resulting from imperfect manufacture.

The effort of the manufacturers of the Packard transformer from the start has been to produce, not a transformer that can be easily repaired, but one that will not require such repairs, and hence in which the feature of cheap repairs ceases to be of any value. Severe tests covering this point have shown almost conclusively that the Packard transformer cannot be burned out under anywhere near normal conditions. The most desired results seem therefore to have been attained, providing of course that no sacrifice is made in other directions. It will be readily believed that no such sacrifice has been necessary as perfect insulation does not conflict in any way with high efficiency or perfect regulation, but is rather an assistance to it. Careful tests extending over a considerable period of time have demonstrated the attainment of the highest results as regards efficiency and regulation.

It will be observed that in mechanical construction the transformer is neat and compact, showing that careful consideration has been given to general detail. The fusing arrangement is most convenient and complete. Throwing back the two round covers or lids discloses two porcelain plugs which carry the transformer fuses. These can be withdrawn and re-fused or another plug inserted almost instantly without the use of any tools or the least danger to the operator.

In the construction of the coils the circular or ring form has been followed, and care has been taken to proportion the windings so that the best possible results will be secured. The point for which the great superiority of the Packard transformer is claimed however, is in the insulation of the tranformer coils. By a new system of insulating transformer windings the manufacturers have been able to secure the result hitherto unknown they believe, in the art, that is, a transformer that can not burn out under ordinary conditions. In the manufacture of the transformer every detail of the work is done only by experienced expert help and no expense is spared to make a perfect machine in every respect.



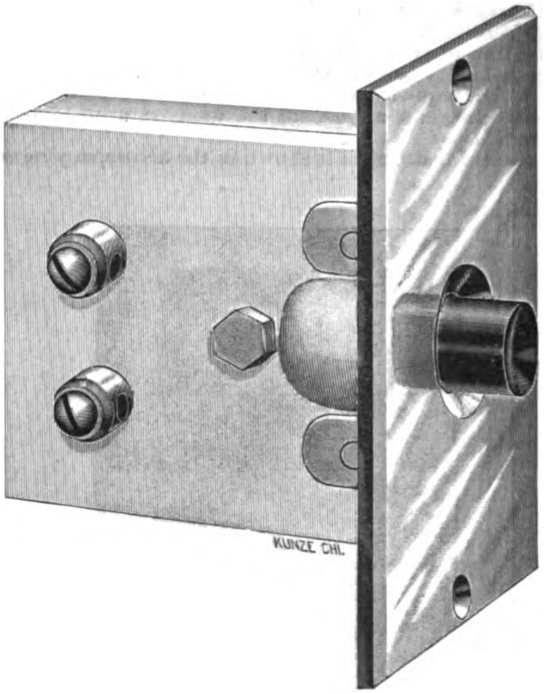
THE PACKARD TRANSFORMER.

The fact that the transformer, as its name indicates, is manufactured entirely under the personal supervision of Messrs. J. W. and W. D. Packard, the manufacturers of the celebrated Packard lamp, is a sufficient guarantee that nothing is spared to make every transformer that leaves the factory as perfect as money, long experience and skilled labor can make it.

The Electric Appliance Company of Chicago have taken the general western selling agency for the Packard transformer and are introducing it extensively in the west.

ELECTRIC APPLIANCE CO.'S NEW ELECTRIC LIGHT PUSH SWITCH.

A brief illustrated description of the mechanism of the new electric light push switch of the Electric Appliance Co. was given in our issue of Jany. 3. We are now able to present a cut showing the external appearance of the finished switch, and bringing out clearly the improved binding post connections, face plate, and general arrangement.



ELECTRIC APPLIANCE CO.'S NEW ELECTRIC LIGHT PUSH SWITCH.

The Electric Appliance Company report that a large number of inquiries resulted from our descriptive article on this specialty, and that the Standard single push switch seems to have already found favor with the trade.

THE OWNERSHIP OF THE WESTINGHOUSE MACHINE CO.

At Pittsburgh last week, says the *Iron Age*, George Westinghouse acquired absolute control of the Westinghouse Machine Company of that city by purchasing outright the entire stock held by Ralph Baggaley. The transaction involved 2000 shares and the price approximated $50 a share, or $100,000. The Westinghouse Machine Company was organized in Pittsburgh in 1881 with a capital of $500,000, $350,000 being common and $150,000 preferred stock. The par value of the shares is $50. The stock has seldom appeared on the market, for the reason that it is in the hands of a comparatively small number of shareholders. Dividends have been earned and declared recently without public notice, and at the annual meeting to be held shortly another dividend disbursement will be made. Mr. Westinghouse has always held a controlling interest in the company, and his holdings now amount to about nine-tenths of the 10,000 shares. Ralph Baggaley has been identified with the company since the inception in an official capacity as treasurer and general manager. No special reason was given by Mr. Baggaley for withdrawing from the company, except that his duties as president of the United States Glass Company made it necessary for him to give that company's affairs his undivided attention. It is believed that Mr. Baggaley will become a large owner of the shares of the glass company. The Westinghouse Machine Company are engaged in the manufacture of high class compound engines, several of which were used for driving the big generators used for lighting the buildings and grounds of the World's Fair. The company ship engines to all parts of the country, and their business is said to have increased to such an extent that the present manufacturing plant is running to its fullest capacity.

ACOUSTIC SYNCHRONIZER FOR ALTERNATING MACHINES.

WITH the extended employment of alternating current machines and with our modern ideas of central station practice, it is frequently desirable to run alternators, both single-phase and polyphase machines in parallel. Although alternators have not hitherto been run in parallel as a general thing on this side, the practice is not infrequent in Europe, where it has been made the subject of much study. The operation of alternators in parallel, however, is receiving more attention here, and a device to indicate in the most delicate, yet effective manner, the exact point of synchronism in speed and coincidence of phase of two alternators has become a necessity. This requirement is met by the acoustic synchronizer, which the General Electric Company has recently brought out, and which is shown in the accompanying engraving, Fig. 1. It consists merely of a cylindrical iron case with an aperture in the side, each end being closed by a flexible diaphragm, each of which has, opposite its centre the pole of an electromagnet.

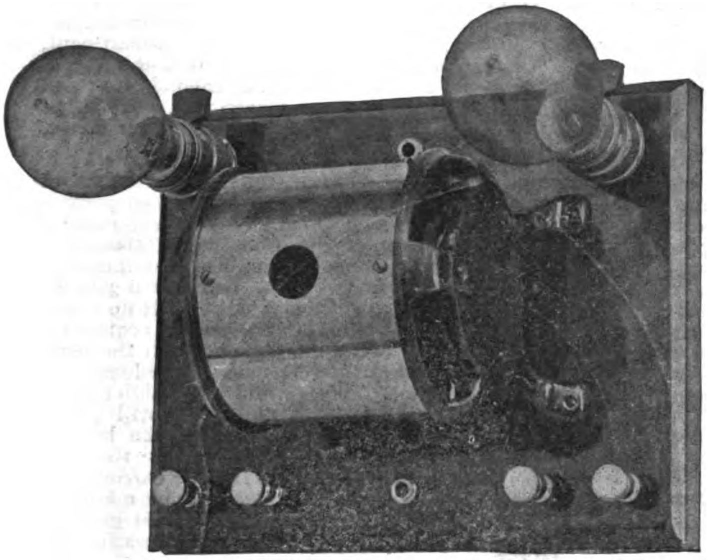


FIG. 1.—ACOUSTIC SYNCHRONIZER FOR ALTERNATING MACHINES.

In using this device one of the magnets is connected in circuit through a transformer with each of the machines to be run in synchronism. The current is then turned into the magnet coils, and the diaphragms emit a loud clear note. As the machines approach synchronism, the notes from the diaphragms approach closer in period and begin that loud, periodic sound, known in acoustics as beats. As the two machines more nearly approach synchronous speed, the beats grow slower and slower, until finally, the diaphragms fall into unison and each gives out the same low, clear note. At this moment, which is sharply marked, the switch connecting the two machines is thrown in. So sensitive and distinct is the indication of approach of synchronism, that it is possible to throw two machines together with hardly a quiver upon the ammeter in actual circuit. The superiority of this acoustic apparatus over the old phase-lamp device, cannot be disputed. It is much more sensitive, indicating distinctly the small differences from synchronism which the phase-lamp fails to detect.

The synchronizer was shown by the General Electric Company in its Power and Mining Department at the Chicago Exposition, where it attracted considerable attention, especially from foreign electricians. When it was shown to Prof. Von Helmholtz and its operation explained, he expressed himself delighted. It was a development in his own field of acoustics and showed how electricity and acoustics could work together for scientific benefit.

In a recent issue we described fully the three phase power transmission plant installed by the General Electric Company at Redlands, California. The switchboard there employed, Fig. 2, is fitted up with its different regulating and controlling apparatus, including the synchronizer, which the irreverent Californians have dubbed the "growler." Its operation is perfect, and it has not been known to fail in its functions in a single instance.

DALE MANUFACTURING CO.

THE DALE MANUFACTURING CO. (John H. Dale and L. J. O'Reilly), of 22 Cortlandt street, have issued a very neat, tasteful and practical catalogue of their electrical fixtures and supplies, including some novelties and specialties of great utility, such as the Dale separable cluster ball made for any number of lights, from 2 to 16. We commend this catalogue to the notice of the electrical trade and community.

THE WAGNER ELECTRIC MFG. COMPANY.

THIS company, St. Louis, Mo., is new enjoying a brisk trade in transformers of all sizes, and also has ready for the market a new alternating current motor in sizes from 1 to 10 h. p. Some of these motors have already been placed and are giving good satisfaction. The Wagner Electric Mfg. Company is glad to notice a distinct change for the better in the general business situation and is prepared to handle all orders promptly.

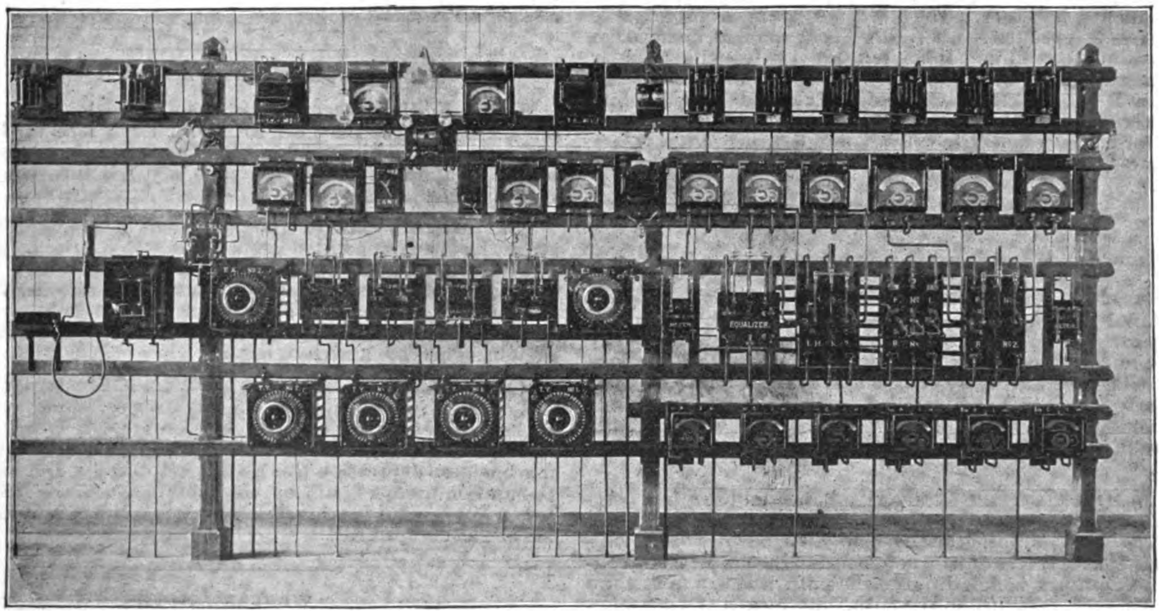


FIG. 2.—SWITCHBOARD OF THE 3-PHASE POWER TRANSMISSION PLANT AT REDLANDS, CAL.

KEOKUK, IA.—Judge Bank of the Superior Court, in Keokuk, Iowa, has appointed H. C. Reiner receiver of the Gate City Electric Street Railway on the application of the Central Trust Company of New York. The trust company holds first mortgage bonds for $850,000, on which the railway company defaulted interest.

"M.-V." AMMETERS AND VOLTMETERS.

Queen & Co., Incorporated, Philadelphia, have some very good commercial ammeters and voltmeters in the "Magnetic Vane" type which they have manufactured in large quantities for several years. These instruments are designed for light and power plants and when placed on a switchboard will indicate current or potential all day long. They are mounted in handsome cases, to present an attractive exterior, and are dust proof and also weatherproof, at least as much so as is possible with first class switchboard instruments. Interested persons can secure a copy of descriptive circular No. 420 by addressing the makers.

THE STEEL MOTOR COMPANY.

The Steel Motor Company, of Cleveland, Ohio, are in a most prosperous condition, and report that they are having all they can do to keep up with their orders. At present they are busily engaged in getting out 20 street railway equipments for use in Cleveland, and 8 for Allentown, Pa.; they have also started work on 100 controllers, 30 of which are nearly finished. The president of the Steel Motor Company is Mr. A. L. Johnson; vice-president and general manager, Mr. Samuel Harris, who is well known as being one of the pioneer electric street railway men of this country.

GOODRICH HARD RUBBER COMPANY.

A couple of very amusing pamphlets have been issued by the Goodrich Hard Rubber Company, of Akron, O., illustrative and descriptive of their electrical and other specialties. It is understood that the Goodrich Company supply wholesale all the best jokes and sketches that appear in *Judge*, *Puck* and *Life*, but that, as here shown, they reserve their choicest wit and humor for their own productions. Bill Nye, Mark Twain and Barrie are on their staff, and edit each other's work, so that only the very funniest things are allowed to see the light. The company ship each of their jokes done up in their tape, or quantities in a hard rubber case. All their goods are warranted the best and entirely free from hard cases.

J. W. PARKER & CO.

Philadelphia has proved too small for the energies of J. W. Parker & Co., agents of the Ball Engine Co., and they have now assumed charge also of the business of that company in New York city and its territory. They will organize a progressive and aggressive department with a New York man at its head, in nowise subordinate to Philadelphia, but both offices will be under the direct management of Mr. J. W. Parker. The business will be known as J. W. Parker & Co., New York and Philadelphia, general eastern agents for the Ball Engine Co., and contractors in general for complete electric railway and lighting steam power plants. No change will be made in the location of the offices in either city.

NEW ENGLAND NOTES.

The Eastern Electric Cable Company, of Boston, have recently declared their quarterly dividend of 2 per cent. Though not so busy as a month ago this company are still doing a very large trade, and are just entering into a number of new buildings which Mr. Clark has recently completed in the vicinity of their present quarters. They have installed a new Fitchburg engine of about 150 horse power, and will now be better situated than ever to take care of all kinds of wires and cables from the smallest to the largest.

The W. S. Hill Electric Company, of Boston, have just completed a novel device for electrically extracting from wood or rag pulp, used in the manufacture of paper, by a series of moving electro-magnets, all traces of iron contained in the pulp. The magnets have long prongs which dip into the pulp, and are in electric circuit so long as they are in the pulp. By means of a sprocket chain the magnets are drawn through the pulp, then elevated to a higher level, where they deposit their pickings of iron dust in a receiving tray, the circuit being broken when the magnets are in the proper position. A jet of water also assists in washing the magnets clean, ready for their next immersion in the pulp. The device is extremely ingenious and yet perfectly simple and practicable, and has proved a wonderful success. Paper manufacturers have experienced great difficulty in the past, on account of the iron contained in paper, and this device ought to eliminate all such trouble in the future. Already a number of important paper manufacturers have seen the working of the machine, and are well pleased with it, and it is almost beyond doubt that the Hill Company will have all they can do for some time to fill orders.

The Simplex Electrical Company of Boston, have recently given up their elegant suite of rooms at 620 Atlantic Avenue, and removed to even more convenient quarters at 75 to 81 Cornhill, Boston. For some time Mr. Mason, the manager of the company, has felt the inconvenience of being so far away from the centre of the city, and has now taken a step by which he will be able to handle their large business with much greater despatch and ease.

Mr. Edward D. Floyd, who has for the past seven years been connected with the Thomson-Houston Electric Company and the General Electric Company, recently in the purchasing department, has resigned his position, and associated himself with the Abbott Wheelock Company of Boston, who are large dealers in iron and steel. Mr. Floyd will be in the selling department, and will be glad to see his numerous friends hereafter at 35, Oliver street, Boston.

The Taunton Locomotive Manufacturing Company of Taunton, Mass., have recently had the right transferred to them to sell and manufacture the goods which have been supplied for years by the Wainwright Manufacturing Company of Massachusetts. For four years the Taunton Company has manufactured all the heaters, condensers, expansion joints, corrugated gaskets, etc., which the Wainright Company have sold, but will now take up also the selling as well. They are thus thoroughly acquainted with the various requirements of customers, and with the technical and engineering features of the business. The long business experience of the Taunton Company and their high reputation are guarantees that the appliances which they will manufacture under the Wainwright patents will be of the highest class, and their excellent facilities at Taunton assure that any business given them will be promptly and skillfully carried out. The various heaters, condensers, joints, etc., will be manufactured in future according to the lists and specifications given in the Wainwright Company's latest catalogue, and prices and discounts will remain the same.

The present agents will continue the sale of the goods on behalf of the Taunton Company and will be glad to furnish any desired quotations. The Wainwright heaters, condensers and other specialties have been very favorably known for years, and are in successful operation in hundreds of central stations for electric light railway and power purposes, as well as in many isolated plants, and will doubtless find even a larger share of patronage under the new management. The Taunton Company have a very large and fully equipped factory, full of the most recent labor saving tools and appliances, and are well equipped for this class of work. Besides the Wainwright specialties the Taunton Company are building a large number of snow ploughs and other devices for electric railroads, and will make an active bid for a share of the engineering work connected with electric development of lighting and power stations.

NEW YORK NOTES.

Mr. E. E. Higgins, expert in street railway values and economies, has removed his office to 26 Cortlandt street. His work is one of peculiar delicacy and difficulty, but is already beginning to be highly appreciated by those who buy, sell and promote electric railway enterprises.

Mr. W. A. Vail, of the Electrical Exchange, 136 Liberty street, has been appointed agent to represent the La Roche Company and apparatus in New York and New Jersey. It is an admirable selection, and though the times are dull, Mr. Vail will not be slow to "seal his contract" with a good order. His energy and popularity are strong factors making for his success, and he now has good apparatus to handle.

Clayton Air Compressor Works.—Working full time and full capacity, and behind on their deliveries, is the gratifying report furnished by the Clayton Air Compressor Works of 43 Dey street, New York, as to their shops in Brooklyn. In the prevailing business depression this speaks volumes for the excellence of the air compressors built by this company. They have recently taken out several patents on a new triple compound high-pressure air or gas compressor.

WESTERN NOTES.

The Brush Electric Co. have issued a most interesting and attractive pamphlet on their exhibit at the World's Fair. It embodies articles and notes descriptive of their large and artistic display, made under the direction of Mr. I. R. Prentiss, and is adorned with many cuts from various sources.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVII. JANUARY 24, 1894. No. 299.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—III.

BY

Mary A. Henry

HENRY used his coil not only in the instruments for experiment, described in his communication to the Albany Institute. He remarks, in a subsequent communication to *Silliman's Journal*; "Several applications of the coil, besides those described in that paper, were made in order to increase the size of electro-magnetic apparatus, and to diminish the necessary galvanic power. The most interesting of these was its application to a development of magnetism in soft iron, much more extensive than to my knowledge had been previously effected by a small galvanic element."[1] This "development of magnetism in soft iron," was the development of the electro-magnet which was to render the lagging force of Volta's battery sufficient for the telegraph.

Before we see how this was accomplished, let us pause for a moment and consider what are the two foundation elements of the telegraph, as it now exists, a thing accomplished. These are the magnet, and the battery with its long conducting wire; these form the magic circuit which in fact constitutes the telegraph. There may be innumerable ways of opening and closing the circuit at one end, and of receiving or recording the message at the other; they are only changeable accessories, which may vary in every country and period. It is the combination of magnet and battery, which gives the power to produce electro-mechanical effects at a distance and *he who brought these two in harmonious accord, so that the one responds to the influence of the other at any distance, is the real father of the telegraph.* Very earnestly would we now ask our readers to remember exactly the state of things when Henry took up this important matter. The battery was in existence, and in its circuit Sturgeon had placed his magnet; yet still the telegraph was an impossibility, pronounced so by eminent men. The electric force diminished with the lengthening of the conducting wire; and repeated experiments only tended to show the impracticability of the scheme. The telegraph is an impossibility on account of the failure of the electric current; such was the conclusion of men of science in 1825 and nothing had come to change this opinion in the three years which had followed.

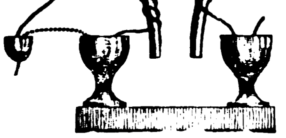


Fig. 1.—Sturgeon's Magnet.

We well remember, when approaching the great city of the past, the thrill with which we heard the cry, ringing out on the night air, "Il trano per Roma." It seems, in view of the long deferred hope of the world, now about to be realized, some such thrill might be felt as we see Henry taking up the feeble electro-magnet, destined under his hands to grow into the instrument which was at last to render the telegraph possible. Let us look again at Sturgeon's magnet, Fig. 1. According to Sturgeon's own description of it, in Nov. 1825, it consisted of a small bar of iron, bent into the form of a horse shoe, having a copper wire wound loosely around it in eighteen turns, with the ends of the wire dipping into mercury cups, the latter connected with the respective poles of a galvanic battery. Under the influence of a battery of *one hundred and thirty square inches of zinc surface, the magnet was capable of sustaining nine pounds.* Up to the year 1828, when Henry began his researches in regard to it, no improvement had been made in the instrument since Sturgeon's time; and if we consider the very large battery required to lift only nine pounds, we can understand the infant it was in strength and—while of undisputed value as a step in the progress of scientific investigation—how utterly unfitted it was for any actual service in either science or the arts.

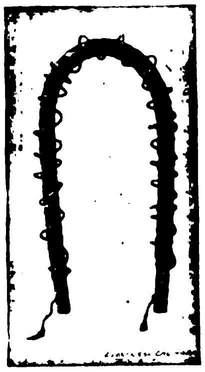


Fig. 2.—Henry's Reproduction of Sturgeon's Magnet.

Henry's first acquaintance with the magnet was in New York, where he had seen it exhibited in some lectures given by Professor Dana. His first step was to reproduce it; we give a picture of the little instrument he made, preserved in Princeton as a relic, Fig. 2. While his hands were busy making it, his thoughts were much upon the theory Ampere had deduced from his brilliant experiments, viz.: that magnetism is produced by electricity, passing around in the magnet like rings at right angles to its length. According to this theory, Henry thought: To make a magnet is to produce these currents in it; and to make a magnet by means of a voltaic current is to lead this current around the iron core of the magnet, as nearly as possible at right angles to its length. Was this condition fulfilled in Sturgeon's magnet? The spirals of the wire were wide apart; they had to be so, otherwise the current would have leapt from one to the other and not have run its desired course through the length of the wire. The current was conducted, not at right angles, but like a corkscrew around the iron bar. What was the first thing Henry did? A simple thing it would seem, but most important. He *insulated the wire*, wound it with silk. "It occurred to me," he said, "that a much nearer approach to Ampere's theory could be attained by insulating the wire conductor and covering the whole surface of the iron with a series of coils in close contact." Following this idea Henry made a number of small magnets closely wound with silk covered wire, to exhibit to the Institute: we give his description of one of them. Its lifting power is not stated, but it was much greater than that of Sturgeon's.

"A round piece of iron about ¼ of an inch in diameter was bent in the usual form of a horse-shoe, and instead of loosely coiling around it a few feet of wire, as is usually described, it was tightly wound with 35 feet of wire covered with silk, so as to form about 400 turns; a pair of small galvanic plates, which could be dipped into a tumbler of diluted acid, were soldered to the ends of the wire, and the whole mounted on a stand. With these small plates, the horse-shoe became much more powerfully magnetic than another of the same size and wound in the usual manner, with the application of a battery composed of 28 plates of copper and zinc, each eight inches square."

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[1] "Scientific Writings of Joseph Henry." Vol, 1, page 88. Smithsonian Institution, 1886.

This magnet "of the same size and wound in the usual manner" is Henry's copy of the Sturgeon magnet with its loose spiral. Henry must have been pleased with the success of his first steps in the improvement of the instrument. Think of the difference. To make this horse-shoe a magnet only two small plates, easily dipped into a tumbler of acidulated water, were needed; while for the Sturgeon magnet of the same size, a large and expensive battery was necessary. Then the difference in power was great. Henry continues:

> "Another convenient form of this apparatus was contrived by winding a straight bar of iron 9 inches long with 35 feet of wire and supporting it horizontally on a small cup of copper containing a cylinder of zinc;—when this cup, which served the double purpose of a stand and the galvanic element, was filled with dilute acid, the bar became a portable electro-magnet."

These articles were exhibited to the Albany Institute in March, 1829.

Finding how much those little willing plates could do, Henry now called upon them for something more.

> "The idea afterwards occurred to me," he said, "that a sufficient quantity of galvanism was formed by the two small plates to develop, by means of the coil, a much greater magnetic power in a larger piece of iron.—To test this a cylindrical bar of iron, ½ inch in diameter, and about 10 inches long, was bent into the form of a horse shoe, and wound with 30 feet of wire. With a pair of plates containing only 2½ square inches of zinc it lifted 14 pounds avoirdupois."

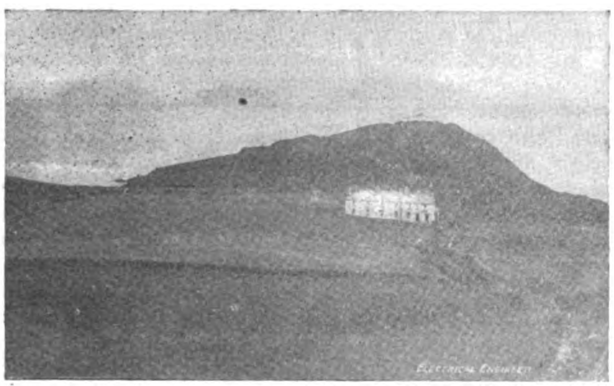
Surely the strength of the magnet was increasing rapidly.

Note: In Chapter II [THE ELECTRICAL ENGINEER, January 10, 1894] the illustration of "De la Rive's ring" would have been better had it shown merely a turn of wire proceeding from the plates. The figure given shows a flat ring which might be taken to include a coil of many turns; whereas the "ring" was originally only a piece of wire bent in ring form.

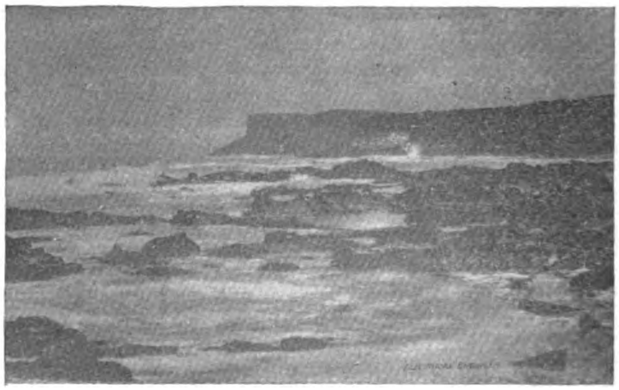
ELECTRICAL UTILIZATION OF THE IRISH SEA TIDES.

BY W'R. LODIAN.

THIS is certainly the age of great engineering projects in bridge building, canal digging and tunnel cutting, while the later years of the century have seen the promotion of several notable schemes for power transmission, among which perhaps that at Niagara is the most conspicuous. The Niagara engineering enterprise rests upon the broadest grounds of feasibility, and the stability and skill with which its plans are being carried out give every promise of a brilliant and enduring success. Of some of the other projects, it is impossible to say as kind a word, strong as may be one's sympathies with daring and enterprise. In this category of the visionary, yet very interesting in its scope and suggestiveness and worthy of record, is the plan seriously proposed for the electrical utilization of the tidal currents of the Irish Sea.



TOR POINT, COUNTY ANTRIM, IRELAND.



FAIRHEAD, COUNTY ANTRIM, IRELAND.

Early in February last the writer concluded a series of hydrographic surveys on the Antrim coast of Ireland, and it was late in August ere a photographic acquaintance, Mr. R. Welch, of Belfast, fulfilled his promise to send views of the ground covered. This delayed the publication of this report, which it was desired to illustrate.

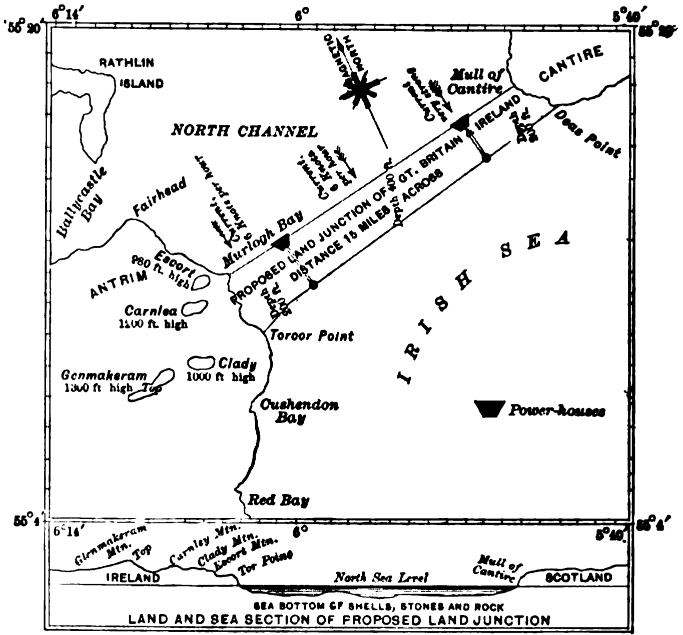


CHART SHOWING THE PROPOSED CAUSEWAY.

The writer was specially detailed to report upon a project to connect Britain and Ireland by a land junction. It was pronounced practicable, but the question was asked: What is the use? That part of Ireland is as wild as Africa. Mr King, the engineer, should build his land junction some hundreds of miles further south—between Calais and Dover. A land junction between France and England would be all above ground and of more stability than bridge or tunnel. As there could be three or four passages for vessels, marine traffic would not suffer interference. But unfortunately, Parliament would never sanction the construction of such an isthmus.

The primary feature of the projected land-junction will be its power-houses, and their use in the generation of electricity from the strong currents always prevailing in that part of the Irish channel. The water-power there running to waste is such that, if utilized, power and lighting could be supplied to the districts for hundreds of miles around. Two power-houses would be ample; one for supplying the Scotch side, the other for the Irish side, and a railroad would run along the isthmus from Cantire to Antrim.

While in the present state of the project, it would be "too much to reveal too much,"—a few extracts may be made from the official specifications, which will show what the constructing engineer proposes to do, and how.

In a direct line north-west of London about 365 miles, and north of Dublin about 126 miles, is the narrow passage between Ireland and Scotland, at the mull of Cantire. The gulf stream, supplying the continuous current flows from the North sea into the Irish sea in volumes of water estimated at many cubic miles daily. The waterway between the head land of Cantire in Scotland and Torhead in Ireland is 15 miles wide, 474 feet deep at mid-current, but much shallower toward either shore. This is the position selected as offering the best engineering facilities for the creation of an isthmus as shown on the chart. The high bluffs of Cantire and the still higher land comprising mounts Clady, Escart and Carnlea near the Irish coast, from 900 to 1200 feet high, offer facilities for gravitating the materials requisite to form the isthmus between the opposite shores. The superficial extent of land required to form the isthmus would be a little more than a square mile, of the average width and depth of 100 yards.

There are no engineering difficulties in the way to prevent the immediate commencement of the undertaking, if favored by national approval and commercial enterprise. The importance and value of the results in the present aspect of affairs in Ireland, cannot be over-estimated. A land junction of Great Britain and Ireland would create a more perfect homogeneity of the united peoples. It would change the Irish Sea into a landlocked bay—lessened in depth by the cessation of the Atlantic current from the north, thereby serving to aid the natural drainage of the adjacent coasts, and make the marsh land of the east coast of Ireland capable of the highest forms of cultivation.

The cost of creating the isthmus would be about two million pounds sterling, and the time it would occupy would be about three years. To maintain a passage of ships to and from the North Sea to the Irish Sea, the Canal of Crinan might be enlarged and another cut through the isthmus of Tarbert.

THE TELEPHONE PATENT SITUATION.—II.

In The Electrical Engineer of Jan. 17th the claim of the patent of Thomas A. Edison No. 474,232 was printed in full; this is the only one of the Edison microphone patents advertised by the American Bell Telephone Co. as covering carbon transmitters. Reference was also made in these columns to the other two Edison transmitter patents. As these patents have been referred to by some journals as being unimportant it may be well for readers to judge for themselves of their importance. Here are the claims:

Claims of patent No. 474,230 of May 3, 1892. Application filed April 27, 1877. Patented in England July 30, 1877.

1. In a speaking-telegraph transmitter, the combination of a metallic diaphragm and disk of plumbago or equivalent material, the contiguous faces of said disk and diaphragm being in contact, substantially as described.

2. As a means for effecting a varying surface contact in the circuit of a speaking-telegraph transmitter, the combination of two electrodes, one of plumbago or similar material, and both having broad surfaces in vibratory contact with each other, substantially as described.

Claim of patent No. 474,232 of Thomas A. Edison, May 3, 1892. Original application filed July 20, 1877, divided and this application filed Feb. 18, 1886. Patented in England July 30, 1877.

A spring forming or carrying one electrode of the circuit of a telephone and constantly pressing against the other electrode and diaphragm to maintain the required initial pressure between the electrodes and yield to the movement of the diaphragm, substantially as described.

Those who are of the opinion that the Blake transmitter, (now that the Blake patents have expired) is subordinate only to the Berliner patent and to Edison No. 474,231, will do well to look carefully at the claim of patent 474,232, even though this patent is not advertised by the American Bell Telephone Co. and would seem to cover only a minor structural device. One of the Government's best points in the suit now pending against the Bell Co to annul the Berliner patent is that several patents of Emile Berliner involving the microphone principle have already had nearly their full term of seventeen years' protection. Among such patents granted to Berliner are Nos. 224,573, 225,790, 241,912, 234,744 and 233,969, the last named being dated November 2, 1880, and being a division of the original application of June, 1877. In this patent are shown the same drawings as appear in the Berliner transmitter patent whose validity is now in question. In fact the patent covers identically the same apparatus so far as mechanical construction is concerned, only the claims upon the device are for its use as a receiver. The application was filed Sept. 3, 1880 and the claims are as follows:—

1. The herein described method of producing sound vibrations in a plate by causing a varying electric current to pass to the plate, or to an electrode connected therewith, from a second electrode in contact therewith, substantially as described.

2. An apparatus for producing sound by means of a varying electric current, which consists of a plate forming or carrying an electrode placed in contact with another electrode, from one to the other of which the electric current is caused to pass.

3. An electric-telephone receiver to be operated by varying electric currents, and consisting of two contact pieces with an electric circuit, one or both of which pieces consist of or are connected with a vibratory diaphragm, whereby one electric current passing through said circuit exercises a repulsion between said two electrodes corresponding to its strength, and thus produces corresponding motions in the diaphragm.

4. A system of two or more telephone instruments in electrical connection with each other, each consisting of two or more poles of an electrical circuit in contact one with the other, either or both poles of each instrument being connected with a vibratory plate, so that any vibration which is made at one contact is reproduced at the other, substantially as set forth.

The application for a patent upon the same organization was filed June 4, 1877, and, after the division above noted, the transmitter patent did not issue until November 17, 1891, as previously pointed out. However long it may take the Government suit against the Berliner transmitter patent to reach a final decision by the Circuit Court of Appeals, or perhaps the Supreme Court of the United States, the device shown and described will be free to the public for use as a receiver on November 2, 1897. In the event of the Berliner transmitter patent being sustained, the condition of affairs from a purely theoretical and legal point of view will be interesting and complex for, whether the device infringe or not will depend upon whether the user places his mouth or his ear to the instrument. In the former case, according to the letter of the law, by using his mouth he will infringe the Berliner patent of Nov. 17, 1891, while in the latter by using his ear he will be free to use the instrument as a receiver in view of the expiration of the patent upon it as such, and he would therefore not infringe. As the device is of no practical use as a receiver, such a question is unlikely to come up; nevertheless a contemplation of this state of affairs is interesting and instructive. As to the three Edison microphone patents, while a decision in the Bate refrigerator case favorable to the Bell Co. would seem to give them the protection of these patents for seventeen years from May 3, 1892, at least one other question would have to be decided—that is, Was the Commissioner of Patents justified in issuing these patents after they had run their full term of fourteen years and had expired in England?

One of the greatest improvements in transmitters was covered by the two patents of Henry Hunnings, a resident of Rothwell, Leeds, England. The first of these patents is No. 246,512 of Aug. 30, 1881. The American application was filed May 14, 1881. The invention was covered by an English patent dated Sept. 16, 1878. The second patent of

Hunnings is No. 250,250 of Nov. 29, 1881. The American application was filed Sept. 30, 1881, while the invention was covered by the same English patent above referred to bearing date of Sept. 16, 1878. The following are the claims in full of both patents.

No. 246,512.

1. As a tension-regulator or means for varying the resistance in telephone transmitters, finely-divided carbon in a loose and free state, substantially as described.

2. The combination, in a telephone transmitter, with a body of finely-divided carbon in a loose and free state, of a vibratory plate or diaphragm for varying the electrical resistance of said body in accordance with its its own vibrations, substantially as described.

3. A telephone-transmitter comprising a thin metallic or metal-covered diaphragm, a back plate, a layer of finely-divided carbon or similar conducting material in a loose and free state inclosed between said diaphragm and back plate, and in a suitable case, substantially as described.

No. 250,250.

1. As a tension-regulator or means for varying the resistance in a telephonic transmitter, finely-divided conducting material in a loose and free state, substantially as described.

2. The combination, with a body of finely-divided conducting material in a loose and free state, of a vibratory plate or diaphragm for varying the resistance of said body, substantially as described.

In the case of these two patents there is no doubt whatever as to the operation of Section 4887 of the Revised Statutes, as the invention was patented in England before the United States application was filed; these patents therefore expired in the United States on Sept. 16, 1892. The long distance transmitter of to-day is frequently referred to as the "Hunnings transmitter." This is a mistake. Two long steps have been taken between the Hunnings transmitter as shown in the above named patents and the beautiful long distance transmitter of the American Bell Telephone Co.—first, in the preparation and perfection of a granulated carbon that is hard, sensitive and that will not pack; second, a transmitter organization which is more efficient than that shown by Hunnings in his patents. As to the granulated carbon used to-day—a carbon which is curiously protected both by a patent and by a secret process—perfection has been reached only after years of research and experiment. The patent covering such carbon is that of Thomas A. Edison, No. 406,567 of July 9, 1889. The application was filed Feb. 19, 1886. The following are the claims.

No. 406,567.

1. An electrode for telephones composed of a body of granules of carbonized hard coal, substantially as set forth.

2. In a telephone, the combination, with a diaphragm, of an electrode composed of a body of granules of carbonized hard coal included in the circuit and acted upon by the diaphragm to vary the resistance of the circuit, substantially as set forth.

3. In a telephone, the combination, with a diaphragm, of an electrode composed of a body of granules of carbonized hard coal, and metal surfaces between which such body of carbon-granules is held, one of such metal surfaces being controlled by the diaphragm, substantially as set forth.

There are many kinds of hard coal and differentme thods of preparing carbon from it. The Bell company have made this the matter of study for years; the particular kind of hard coal which is used, and the process by which the powder is prepared, are kept secret even from most of their own employes. There are, however, other good carbon powders available, such, for instance, as artificial or treated powders. A reference to the patent of J. H. Irwin, No. 238,784 of March 15, 1881, discloses the following claims: "A telephone or microphone resistance contact treated or saturated with a non-conducting substance or liquid." A more recent patent covers the use of paraffine in such treatment. If the American Bell Telephone Co. are in possession of the Irwin patent it can be well understood why they should not lie awake nights over the paraffine patent above referred to. The second and perhaps most important step towards the perfected long distance transmitter was taken by the late Anthony C. White, whose invention is covered by patent No. 485,311 of March 24, 1892. While long distance transmitters have stamped upon them dates of other patents, the American Bell Telephone Co. either through accident or through design, seem to have omitted to place the date of this most important patent upon their instruments involving the invention—at least upon some of them. This instrument is known among telephone people as the "Solid-back" transmitter and was illustrated and described by THE ELECTRICAL ENGINEER in its issue of November 16, 1892, page 477. Preece and Stubbs in their new work on the telephone have taken their description amd illustrations from that article, giving credit to THE ELECTRICAL ENGINEER. The claims of the patent upon the "solid-back" transmitter are as follows:

1. The combination, with the sound-receiving diaphragm D and a supporting-frame therefor, of the independently-supported heavy chambered block W and electrode B, secured thereto, the flexible disk *m*, and piston-electrode E, carried thereby, and the finely-divided conducting material within the chamber in said block and extending about the periphery of said piston-electrode E, substantially as described.

2. In a granular button for a transmitting-telephone, the combination, with the heavy chambered block W, electrodes B and E, and finely divided conducting material P, of the mica spring-disk *m*, carrying the electrode E and confining said granulated material within the chamber in said block W, substantially as described.

The "solid-back" transmitter seems to depend largely for its sensitiveness upon the countersunk recesses for the reception of the granulated carbon; in other words, the efficiency of the transmitter is due to friction as well as to variable pressure, and while there is an actual compression of granules of carbon by the piston electrode, yet there is also a difference of resistance due to the varying number of particles lying directly in the circuit.

One of the most interesting and beautiful inventions touching telephone transmitters is covered by Mr. T. D. Lockwood, in his patent No. 435,438 of Sept. 2, 1890. The first claim of this patent is:

1. The hereinbefore-described improvement in the art of transmitting articulate speech, which consists in transforming an electric current which varies in strength only into a current or series of currents varying also in direction, the potential being unchanged, and in then transforming the said alternating currents into a second series of alternatiug currents, and in simultaneously raising the potential under which the last series is developed.

Those interested in the possibilities of the induction coil will do well to send for this patent and examine it carefully. The specifications and claims are also a masterpiece as to both terseness and inclusiveness. There are more than a hundred minor transmitter patents which are hardly of sufficient importance to be touched upon here, but which should be familiar to the would-be inventor or investor; these patents cover for the most part special mounting either of electrodes or of diaphrams.

Summing up the patent situation as regards the carbon transmitter, there is no broad patent covering the use of carbon in transmitters; there is a patent covering the use of the special powder employed in the long distance transmitter; the Blake transmitter is still covered by the patents of Berliner, Edison and others; the Hunnings patents, covering the use of granulated carbon, expired in this country on Sept. 16, 1892, and the use of such carbon is free, provided a transmitter structure is employed whose action does not depend upon variable pressure between electrodes in constant contact, and also provided that no induction coil is used; the broad patent upon the use of the induction coil in connection with battery transmitters will expire Jan. 15, 1895, after which should a non-infringing carbon transmitter not have appeared meanwhile, inventors may find it profitable to turn their attention to liquid transmitter patents covering devices in which the variation of resistance is effected by a variation in the amount of immersion.

THE electrical engineer of one of the leading electric railway roads of the South writes us in renewing his subscription: "**THE ELECTRICAL ENGINEER** is indispensable to the practical man."

SELF INDUCTION AND BI-METALLIC TELEPHONE WIRES.

BY

A. N. Mansfield.

RECENT articles in THE ELECTRICAL ENGINEER show the important role played by inductance in the transmission of telegraphic and telephonic signals, and attention was called in an article in the ENGINEER of January 10, to the remarkable properties possessed by bi-metallic wires. In connection with this article it will be interesting to inquire into the difference in inductance possessed by bi-metallic and ordinary copper circuits.

The effect of self induction is to annul, to a certain extent, the harmful properties of capacity; but it is very important to take cognizance of the fact that this capacity is equally distributed along the line. If we have a circuit with a localized capacity we can overcome its effects by the insertion of a localized inductance. It may not be necessary to completely overcome this effect but simply to properly proportion the capacity and inductance so as to make the circuit resonant. This resonance would be for a stated rate of alternation and would answer for rapid telegraphic work, but not for the telephone. It is seen therefore, that in order to act on a distributed capacity such as a telephone line we must have a distributed inductance. Let us examine a few of the ways in which this may be attained.

First: Increasing the distance between our wires. While this would increase the inductance and diminish the capacity a limit is soon reached by the dimensions of the pole line.

Second: Diminishing the diameter of the wires. While this would increase the inductance it would also increase the resistance of the wire, in as large a ratio, which is not practicable.

Third: By the use of iron wires. Here we would have a marked increase in inductance and also in resistance. The resistance increase will be very marked on account of the skin penetration and would be large for high rates of alternation.

Fourth: By the use of an iron wire with a coating of copper. The copper coating gives the conductance, but the iron is very poorly situated for increasing the inductance. It is important to note that in all cases we must bear in mind the effect of the skin penetration.

Lastly, consider the case of a copper conductor surrounded by a dielectric impregnated by iron dust. Here we have the conducting properties of the copper and the increase in inductance due to the surrounding ferruginous dielectric. We might take as a limiting case of this a bi-metallic wire, copper core and iron sheath. In this limiting case we have increased the resistance owing to the proximity of the iron, but to what extent must be determined by experiment.

The method of increasing the inductance by the insertion of inductance coils does not appear to be wholly feasible, as we are treating distributed capacity by a number of localized inductances. In the limit we would have a line made up of inductance coils, which is impracticable.

It would appear then, that the proper way to insert inductance would be by the use of a wire made up of a copper core and an iron sheath. A large amount of experimental work would be necessary in order to determine the proper dimensions of the copper and iron. It has been pointed out that in the case of distributed capacity we do not get the maximum current effect by neutralizing the capacity by an inductance, but by so proportioning them that we have a resonant circuit. Hence the proper field of work appears to be, to increase the inductance until we have made the circuit resonant.

Further reference to methods of increasing the inductance of pole lines will be found in the articles by Heaviside on "Electromagnetic Theory" in the London *Electrician*, especially under date of November 3, 1893.

THE LIMITATIONS TO LONG DISTANCE TELEPHONY.—IV.—(*Concluded.*)

BY

F. W. Dunbar

COMPARING the resulting currents at the distant end for the several cases we have :

First.—When C and L are each zero and the equation reduces to $I = -\frac{2E}{lR}$ which is Ohm's law with its proper sign

$$I = -\frac{2E}{2{,}000 \times 2.2} = -2E \times .000228 \text{ ampere.}$$

Second.—$C = 0$ and $L = .0016$ (the probable value of L on the Chicago line).

$$I = -\frac{2E}{l\sqrt{R^2 + L^2\omega^2}} = -\frac{2E}{2{,}000\sqrt{4.84 + 2.56}} =$$

$-2E \times .000184$ ampere.

Third.—$L = 0$ and $C = \frac{.017}{10^6}$ (actual value of C on Chicago line).

$$I = -\frac{2E\sqrt{C\omega}}{\sqrt{R}\, e^{\left(\sqrt{\frac{CR\omega}{2}}\ \frac{l}{2}\right)}} = -2E \times \frac{4.12}{1.49\, e^{4.32}} =$$

$-2E \times .000037$ ampere.

Fourth.—$L = .0016$ and $C = .017$ (condition in practice on Chicago line).

$$I = -\frac{2E\sqrt{C\omega}}{\sqrt[4]{R^2 + L^2\omega^2}\ e^{\left(\frac{l}{2}\sqrt{\frac{C\omega}{2}}\sqrt{(R^2+L^2\omega^2)^{1/2} - L\omega}\right)}} =$$

$$-\frac{2E \times 4.12}{10^3 \times 1.65 \times e^{3.06}} = -2E \times .000122 \text{ ampere.}$$

Fifth.—$C = .017$ and L that value which will make I a maximum, *i. e.*, $L = \frac{C l^2 R^2}{16} = .0204$. The exponent of e will in this case be small and it becomes necessary to determine the wave length and from it the ratio of l to x_λ. This ratio will determine whether the exponential factor should take the maximum, minimum or mean value

$$\frac{e^{\frac{pl}{2}}}{e^{pl} - 1},\quad \frac{e^{\frac{pl}{2}}}{e^{pl} + 1} \quad \text{or} \quad \frac{1}{e^{\frac{pl}{2}}}, \text{ respectively.}$$

$$\text{From (7) } x_\lambda = \frac{2\pi}{\sqrt{\frac{C\omega}{2}}\ \sqrt{(R^2 + L^2\omega^2)^{1/2} + L\omega}} =$$

$$\frac{6.28 \times 10^3}{18.62} = 335 \text{ miles.}$$

Hence $\frac{l}{x_\lambda} = 6$, approximately. Therefore the current equation assumes its maximum value $\frac{e^{\frac{pl}{2}}}{e^{pl} - 1}$.

Substituting we obtain :

$$I = -\frac{2E \times 4.12\, e^{1.00}}{10^3 \times 4.53\, e^{2.00} - 1} = -2E \times .000384 \text{ ampere.}$$

Had $\frac{l}{x_\lambda}$ been 6.5, and therefore the exponential of minimum value, the factor $e^{2.00} - 1$ would have changed to

$e^{2.00}+1$ and $I = -2\,E \times .0003$ ampere. These calculations show that were it possible to maintain the capacity of the Chicago line constant and to increase its inductance from zero to .0204 henry per mile, the value of the current at the distant end would gradually increase from $.037 \times 2\,E$ milliamperes to a maximum of $.38 \times 2\,E$ milliamperes; and that the value of the inductance which occurs in reality, although less than one-tenth that value which renders I a maximum, yet brings the current to one-third its maximum value. At the same time it is but little over one-half the value that would be obtained were the line devoid of capacity and inductance, and but two-thirds the value that would result were the line free from capacity alone.

The important result, however, is, that by the addition of suitable capacity and inductance a value of the receiving current may be obtained greater than that which would be obtained were the line free from both capacity and inductance.

Formula (12) may be written

$$\frac{l}{2}\sqrt{\frac{C\,\omega}{2}}\,\sqrt{R.} = 1 \qquad (13).$$

This value $\frac{l}{2}\sqrt{\frac{C\,\omega}{2}}\,\sqrt{R.}$ is the exponent of e in (4) and indicates than when the exponent assumes the form e^1 the value of the current at the distant end is a maximum.

From the results just deduced it might appear that the value of the received telephonic current on the Chicago line would be but little affected by the presence of the line capacity. But a further consideration will show what has limited the transmission of speech and caused the insertion of 400 tons of copper wire to conduct a conversation a distance of less than 1,000 miles.

Equation (3) expresses the current at the transmitting end. Substituting we obtain

$$I = -\frac{E\,\sqrt{C\omega}}{\sqrt[4]{R^2+L^2\omega^2}}\;\frac{e^{pl}+1}{e^{pl}-1} = -\frac{E \times 4.12}{10^3 \times 1.65}$$

approx. $= -2\,E \times .00125$ ampere, a value over 10 times greater than the received current and seven times greater than though the line were devoid of capacity and inductance. If the transmitting device were capable of maintaining a constant potential it would have to give out seven times the energy to secure one-half the current at the distant end on account of the capacity of the circuit. But the induction coil used in the transmitting circuit of the telephone is far from being a regulating device. Aside from its relatively high impedance, which of itself enormously reduces the potential at its terminals, the coil is capable of giving out but a definite amount of energy. A demand for more current can only be met by a fall in E. M. F.

Thus on open circuit the coil during conversation frequently exceeds 100 volts; when closed through a voltmeter of a few thousand ohms resistance it gives a potential of 25 or 30 volts; and when connected to a line such as that under discussion it can only furnish two or three volts to the circuit.

Hence we may conclude that the only cause which has limited the extension of long distance telephony, or which seems at all probable to limit its extension—that of the decrement of current due to the capacity of the line—is itself due *to the use of a transmitting device devoid of regulation.* It is not within the scope of this paper, however, to discuss the increased induction disturbances which would be a natural result of the adoption of a transmitter capable of maintaining a constant potential to line.

The importance of the value of the factor R must not be neglected. Equation (11) shows us that the value of L which secures a maximum current varies with the square of the resistance. If then the resistance were decreased from 2.2 to 1 ohm per mile this value of L would reduce to .0041—a value but 2½ times as great as the actual value, and close enough to it to produce nearly the maximum value of the current. A calculation using 1 ohm in place of 2.2 yields

$$I = -\frac{2\,E \times 4.12 \times .334}{10^3 \times 1.37} = -2\,E \times .00100 \text{ ampere.}$$

Thus a decrease of 55 per cent. in the resistance yields eight times the current at the distant end and places the constants in such a relation that no material increase could be secured by a farther increase in the inductance.

A similar course of reasoning shows that the adoption of the 435 lb. wire (per mile), on the Chicago line, in place of the hitherto standard 173 lb. wire, allowed an increase of eleven times the current at the receiving end. Thus, substituting $R = 5$, in place of 2.2, and $C = .014$, in place of .017, we have, $I = -\frac{2\,E \times 3.74}{10^3 \times 148} = -2\,E \times .000011$ ampere.

All of this huge gain was not, however, realized, for reasons already pointed out; the transmitter could not maintain the potential. The substitution of the 435 lb. wire called for an increase of 50 per cent. in the current at the transmitting end and the potential had to decrease to meet the demand and with it decreased the current at the distant end, and in the same proportion.

In conclusion we may say that under the present system the limitation to the transmission of speech by overhead lines is the price people are willing to pay for the privilege. For, by employing about eight times the amount of copper it is possible to double the distance that has already been successfully talked over. But if a constant source of E. M. F. were employed at the transmitting end there would be no apparent limit to the extension of telephony by overhead construction.

It has already been shown, in article I, that the distortion of the *form* of the wave, due to the unequal displacement of phase in the component parts of the complete tone, does not, as assumed by many writers, cause a distortion of the sound as the ear appreciates it and does not impose any limit whatsoever upon long distance telephony.

It has also been shown in articles II and III that the distortion of the wave due to the unequal decrements of the component parts of the complete tone has never in practice cut any figure in long distance transmission and that when the lines are so constructed as to bring them into "resonance" and thus secure the maximum current at the distant end, even the slight distortion which now theoretically exists, will completely disappear even upon the longest lines.

The problem of a cable is different only in respect to the relative values of the constants C and L. As the two sides of the circuit approach one another the capacity increases and the inductance decreases. This increases the discrepancy between the actual value of L and that value which will produce a maximum current at the distant end. But if the inductance be increased either by separating the return wire, or by the addition of artificial retardation, or by a combination of the two methods, one circuit at least could be rendered capable of almost indefinite extension.

CONDUCTING POWER OF DIELECTRIC LIQUIDS.

If it be assumed that electrical conductivity in dielectric liquids is of the nature of electrolysis, we must look for galvanic polarization in two electrodes inserted in it and connected with a galvanic battery. A capillary electrometer, in which the electrolyte is the liquid itself to be investigated, may be made so sensitive that the existence of polarization, and also of electrolytic conductivity, may be demonstrated. The thermometer should consist of a horizontal tube about 1 mm. bore, connected on each side with a mercury cup; the mass of mercury in the tube is separated by a drop of the substance to be investigated. If the two mercury cups be connected with the poles of a battery, the drops will move one way or the other, according to the direction of the current, if the liquid conducts electrolytically, and thus when polarization takes place at the opposite surfaces of the mercury.

THE COPPER-ZINC ACCUMULATOR.—I.

BY

D Paul Schoop

At the present time the question of traction by means of accumulators has again come to the front among the topics of discussion by electricians. But more recently it has not been the much-hoped-for and at the same time so much abused lead accumulator, which takes the lead in the discussion, but it is that less known form of secondary battery, frequently called the alkaline accumulator or the copper-zinc secondary battery.

To those not especially engaged in the trade or manufacture of this type of battery, most likely very little will be known about it since the literature on it is meagre and perhaps not more than two dozen patents have been taken out on this type; and even such patent descriptions do not afford much of an insight into this type of battery, so entirely different is it from the better known lead cell on nearly every point of importance. The writer, having had opportunities to study the subject more closely, both from a theoretical and practical point of view, will try in these articles to give an idea of the present state of the copper-zinc accumulator.

This type of secondary battery is of quite recent invention, but its history is, perhaps, as old as that of the lead cell. Without tracing it to its origin, it may be stated, that the French chemist Lalande was probably the first who brought the galvanic combination, viz., copper (in oxydized form): zinc and caustic potash (dissolved in water), into practical prominence. Many years before Lalande's name became known in this country by its connection with that of Mr. Edison in the primary battery known as the "Edison-Lalande" cell, the French chemist had developed the above mentioned combination. Although Lalande calls his combination a primary battery, it is well to remember right here, that it is *reversible* in its action, that is to say, by passing an electric-current in the opposite direction to that delivered by the discharging of the cell, it will again recover to the original state of the cell before the discharge. It is now about ten years ago that Mr. Desmazures, of Paris, with the financial help of Messrs. Bailhâche and Commelin, made his first efforts on a practical scale, to put the Lalande cell into the shape of a secondary battery cell. It is about seven years ago that the French submarine boat "Gymnote" made its trial trips with the Desmazures battery and proved a complete failure.

But since that time electricians have worked steadily on improving the copper-zinc accumulator. At the beginning of last year, the firm, Messrs. Pulsford & Triquet, of Paris, looked into the Desmazures cell, but nothing has as yet been heard of putting the accumulator into practical use. If the writer is correct, three years ago Messrs. Phillips and Entz took up the question anew, and so far have gone farther than any one in putting the copper-zinc cell into practical use. Owing to a peculiar and, no doubt, ingenious construction of the copper-anode (Mr. Phillips' mat of copper-cable), certain defects of the Desmazures cell have been eliminated, whilst the result of the trial with six cars on Second avenue, New York, may perhaps prove that the general working conditions of the Wadell-Entz accumulator are at least so far advanced as to render this apparatus capable of more extensive use. Dr. Boettcher in Leipsic, Germany, has devoted several years of study to the solution of the copper cell question; so also has Professor Aron, who took up the subject ten years ago, and added much to our knowledge on it. Americans also well remember the late Mr. Slattery, who worked in this line, and no doubt a good many others have gone in for the same object.

The history of accumulator traction is not a happy one; nowhere has this mode of traction achieved a complete success as yet, although all the better systems of accumulators have been tried and sometimes under good conditions. Like a will-o'-the-wisp, the coming accumulator for traction work has thus far kept at a safe distance. Will the copper-zinc cell follow the same example or will it be of a a less deceptive character? Is it likely to be "practical?" Will it require more or less attention during its life than a lead cell? Will it be more durable, more reliable, as efficient as the lead cell? These, and many similar questions must arise before an exact estimate on any practical scale will be possible. And after knowing a little about those details, reports from several quarters, as many as possible, should be forthcoming, telling the tale of praise or dispraise, as it will be, according to the merits of each accumulator.

In what follows the writer proposes, first, to give the chemical foundation of the copper cell; afterwards a short description of the Desmaszures and of the Phillips-Entz (Waddell-Entz) cell will follow and then the peculiarities of this type of accumulator will be treated of.

Lalande's cell. If a copper-sheet, whose surface is covered with the black oxide of copper, is placed in a vessel, filled with a solution of 1 part of caustic potash in two parts of water, and a zinc plate is placed opposite the copper sheet, a primitive form of Lalande cell is established. By closing the circuit, that is, connecting the copper with the zinc plate, a current is set up. After some time, all of the black oxide of copper will have disappeared and a brick-red color of the copper sheet will first be noticed, indicating that the oxide of copper has been changed into a lower oxidized form, the suboxide of copper, which has a red color. But after a short while, the red appearance vanishes and the more yellowish, bright, metallic tint of pure copper manifests itself. On the other side it will be noticed, that the caustic potash solution (the electrolyte) dissolves part of the zinc plate; heavier streams of liquid sink down along the zinc plate, as may be seen by looking through the glass cell. The caustic potash solution has taken up some of the zinc, in the form of zincate of potash, as this zinc compound is called. As long as there is a trace of the black oxide of copper, the difference of potential between the terminals of the cell is 1.03 volt; but when the red suboxide of copper only is present, 0 85 volt difference of potential will be found between the two electrodes and it is safe to say, that not the slightest trace of oxygen will be found at the copper side, when the potential has fallen to zero.

The electro-chemical process is perhaps as follows: The zinc decomposes the caustic potash (K O H) by absorbing its oxygen and thus forming oxide of zinc. Of course there remains potassium as a free element. Now neither of these two newly formed bodies can exist unaltered under the present conditions. The oxide of zinc dissolves in the excess of the caustic potash solution, forming the already mentioned streams of heavier liquid, sinking down along the zinc plate. The potassium decomposes the water of the potash solution and combines with its oxygen, forming again caustic potash (which dissolves in the surrounding solution), while hydrogen is set free. But no gaseous hydrogen can be seen, since it is at once absorbed by the oxide (or suboxide) of copper, thus reducing the oxidized copper to its metallic state while the result of this last combination between the hydrogen and the oxygen of the copper oxide (or suboxide) is water, the latter mixing again with the surrounding liquid.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC ROADS IN COUNTRY DISTRICTS.

In a recent communication from Columbus, Ohio, the New York *Evening Post*, presents the following interesting data on the subject of electricity as applied to country roads the State of Ohio:—

The discussion of road improvement has received a unique and original contribution in the report of an Ohio commission appointed last spring by Gov. McKinley, under direction of the Legislature, to investigate the subject in all its relations. The Governor appointed Martin A. Dodge of Cleveland, the author of the resolution who is an enthusiastic advocate of the application of electricity to country roads, David S. Oliver of Cincinnati, J. H. Dunlap of Hardin County, and D. W. Sprague of Lake County upon the commission. A careful investigation was carried on throughout the summer, and the result is a report of more than usual interest.

It shows that in two-thirds of the counties of Ohio there are nothing but common dirt roads; which are well-nigh impassable a third of the year. The cost of macadam-turnpikes ranges from $1,500 a mile in counties like Miami and Union, where a good quality of gravel is ready obtainable, to $10,000 a mile in Muskingum, where limestone is the only material available. The mileage of common roads in the state is 80,000 in round figures, and only 11,500 miles are improved, 7,000 macadam, and 3,500 gravel. The cost of moving freight over the roads of the state is reported to vary in different counties from 10 to 25 cents a ton. The commission estimates that it would require the enormous sum of $400,000,000 to improve all the roads in Ohio, and that even then the actual cost to the farmer of transporting his products to market would exceed 10 cents a mile and probably approximate 25 cents per ton. In the city of Cleveland, with paved streets, for example, the commission's inquiries lead to the conclusion that the average cost of drayage is not far from 25 cents a mile per ton. The commission holds that comparisons prove "that the steam cars and the electric cars have already contributed more to cheapen transportation without the aid of public money than the wagon-road improvement has done with the aid of public money."

Regarding the proper authorities to be charged with road improvement the report says:

Without going into an exhaustive discussion of the subject, we are convinced that national or state aid is unwise, and that with the governmental machinery existing in Ohio, the county authorities are the proper ones to manage road construction, and that the necessary funds should be raised within the limits of the county where the roads are built. The community of interest in a county is such that it may properly be considered a unit in the matter of road building, and the fairest plan for all concerned is, perhaps, to assess a portion of the cost upon the abutting land, and place the balance upon the general tax duplicate. . .

The people who use a road are those living in the immediate neighborhood. Statistics are not at hand, and perhaps could not be gathered, but it is safe to say that the average haul on our roads is not over five or ten miles at the outside. No one would pretend for a moment that a pike between Cincinnati and Cleveland was necessary or desirable on account of the through traffic between those cities. Further, it is largely a matter of indifference to the citizens of Cincinnati whether there are good roads leading into Cleveland or not. They are only concerned with the condition of the roads about their own city. Therefore, it cannot be asserted with any degree of truth that the building of roads is a concern of the state at large, and that the state as such should raise money by taxation to be expended by her in improving the roads where good roads are lacking.

Regarding the application of electricity to the country road, the commission begins with this interesting paragraph:

There is another consideration that should deter us from entering upon any extensive scheme for improving our roads requiring the expenditure of vast sums of money. It is a significant fact, to which attention has been frequently called, that the history of the development of the means of transportation shows no instance in which, after a better means has been devised, mankind has gone back to a former method. Every improvement in the means of transportation reduces the comparative value of the former means of transportation and frequently destroys is altogether. The bridle-path and the pack animal disappear as soon as wheeled vehicles are placed upon the common roads in competition. The ox-team is abandoned for horses, and the post-rider for the stage-coach. These, in turn, all give way and disappear wherever it is possible to introduce a steam-car or an electric car. It is undeniable that the development of the railway arrested the building of wagon-roads on a large scale, such as the "National Road" running through Ohio. The horse-car in cities superseded other methods for carrying passengers, and the electric and cable-cars have about rendered the horse-car obsolete. With the advent of the electric car has come a development along a line totally unexpected, and that is its extension into the suburban and rural districts. It is too early to predict the extent to which the building of electric railways in the country districts will be carried. The franchises that are being granted for construction of electric lines connecting different towns would seem to indicate a possible expansion in this direction hitherto unthought of. There are no reason why these railways should not be carriers of freight as well as passengers, and it is not at all visionary to surmise that as the steam railway superseded horse-power for long hauls, so the electric railway may supplant it for short hauls.

A diagram is presented showing the relative distances over which $1.25 will carry a ton of freight on wagon, electric road, steam railway, and lake steamship. They are respectively 5, 25, 250, and 1,000 miles. The commission concludes "that steam-cars and electric cars are both better means than horse-power, so far as they can be applied," and it continues:

This may certainly be assumed: That we are only at the threshold of the door that leads to a more extended use of inanimate power to take the place of animal power as a means of transportation; that more electric roads will be built; that they will be almost innumerable, in fact unlimited, is evidenced by every indication, so that the problem of building the wagon-road is made easier and easier by reason of the shortened distances for which horses may be profitably used for purposes of transportation. Five miles will probably measure the distance beyond which the horse cannot be used either for pleasure or for profit. It should also be observed that the ordinary earth road when in good condition, as it is during most of the year, is more suitable for light purposes and pleasure driving than macadamized roads or roads made hard with any kind of metal. By introducing the iron rails and inanimate power for rapid transit, and to take the heavier loads, the problem is solved.

The commission accordingly recommends "masterly inactivity" in the matter by the Legislature and discourages schemes calling for large expenditures and involving a heavy increase in local indebtedness,

A minority report signed by Martin A. Dodge and D. W. Sprague, two of the commission, goes much further than the main report in advocacy of electric roads through the country districts. It shows that the power necessary to move a ton of freight over steel rails is one-eighth that required on a macadam road, one-eighteenth that on a graveled road, and one-twenty-fifth that on a common dirt road in fair condition, and declares that "the profitable use of steel rails and the application of inanimate power can only be limited by the convenience or inconvenience of terminal facilities." The conclusions of this minority report are radical and are summed up in the following paragraph:

It seems probable that the application of electricity to the cars upon our streets and roads is destined to do for the short haul what the steam-cars have alrady done for the long haul. So far as electricity has been applied already, it has shown that the cost of transportation by that means is far less than upon the steam-cars, which is indicated by the rate of charge for transportation—the common rate upon steam-cars being three cents per mile for passengers, while in many cases upon the electric cars it is but one cent or even less per mile. What has been done by way of cheapening transportation of passengers may be done to a great extent in cheapening the transportation of certain kinds of freight, especially the food products that are raised upon the farms and conveyed to the markets for immediate consumption. This may be done either with or without the aid of public money. Neither the steam-cars nor the street-cars, up to the present time, have received the aid of public money; but one element in the cheapening of transportation, which has assisted the electric street-cars, is the use of the public streets and roads, which, though not money, is a contribution as valuable as money itself. The cheap rates which prevail upon the street-cars could never be attained if the companies that operate these cars were obliged to appropriate and buy the lands upon which they build their roads; so that public aid, though not public money, has been given—and properly given—to cheapen transportation by that means.

In the article on "Electric Chain Traction for Canals," by Mr. Jules Neher, in our issue of Jan. 17, a typographical error in the third paragraph made it read that "rolling traffic is *cheaper* than floating." It should have read, "*quicker*."

A PLAN OF TROLLEY LINE REGULATION FOR BROOKLYN.

Mayor Schieren has been considering the trolley question since he has entered upon his duties as Chief Magistrate of Brooklyn. He enjoys unusual advantages for observing the work of the trolley cars, as nearly all the lines in the western district run past the City Hall.

During the morning and evening "rush hours" and in the afternoon when the shopping traffic is heaviest, there are almost continual blockades of trolley cars on Fulton street, opposite the Mayor's office. This has impressed the Mayor with a sense of the gravity of the situation. He has spent a good deal of time thinking about it.

"I believe it would be a good idea to have inspectors patrol the streets on which trolley cars are run, whose duty it should be to arrest motormen who indulge in reckless running," the Mayor said recently. "I have laid the scheme before the Board of Subway Commissioners, and they are now considering it.

"I am in favor of fixing a maximum rate of speed for the cars which shall not menace the lives of the people. The question is too important to be disposed of hastily, but when I get ready to act, I will present my views to the Aldermen."

President Norton of the Atlantic avenue system says he thinks every person who gets run over by a trolley car ought to be arrested. He says that is the way they do in Berlin, and he thinks the custom a good one. He does not think the motormen who kill human beings should be arrested. People are killed because of their own carelessness.

ELECTRIC "SNUBBING" ON THE ERIE CANAL.

Cruising along a canal and digging the boat's nose occasionally into the bank is known technically among canal men as "snubbing," and it is now intended to electrify that branch of occupation as well as others. Mr. Frank W. Hawley, who had charge of the canal electrical experiments near Rochester in December last, will ask permission of the Superintendent of Public Works to operate his boat on the State waterways next season as a sort of object lesson in the uses of electricity. He proposes to have a new boat of the most approved pattern, equipped with a propeller wheel of the latest design, and in place of the trolley used in the experiments already mentioned, proposes to use storage batteries to operate the Westinghouse motors that drive the shaft to which the wheel is attached. Two series of storage batteries will be used. On one side of the boat will be ranged the chloride accumulators of the Electric Storage Battery Company, and on the other side a series of batteries furnished by the General Electric Launch Company of New York. It is the intention to place upon this electric boat a number of devices for the use of electricity in daily life, and to exhibit these everywhere along the line of the canal.

A NEW KIND OF COUNTER WEIGHT RAILWAY.

The Oil City, Pa., Passenger Railway Company, is about to make a novel experiment in engineering. The company has put in an electric street railway system and is ready to operate its cars. One of the streets has a very heavy grade, both difficult and dangerous, if not altogether impracticable by ordinary means.

It is proposed to assist traction up hill and retard descent by lowering and raising a weight as heavy as a car. A hole 1,000 feet deep has been drilled in the street at the top of the heavy grade, and in this is to be suspended the weight, attached to one end of a steel cable, running over a pulley, while the cars are attached to the other end by an adjustable clutch.

When a descending car has reached the foot of the hill an adjustable clamp holds the weight at the top until an ascending car is fastened to the cable. The weight is then released and descends as the car moves up the grade.

Why two cars are not made to balance one another—the one going up while the other comes down—and the necessity for the hole in the ground avoided, is not stated.

THE LAWRENCE ELECTRIC RAILWAY.

Among those competing for the $50,000 prize offered by the Metropolitan Traction Company, for a railway equal to the trolley system without overhead or other objectionable features, is Mr. William Lawrence of the Lawrence Electric Company with offices at 13 Astor Place. His system employs a conduit of vitrified clay and a sectional trolley wire normally out of contact with the feed wire and entirely dead except during the passage of a car. The conductor sections are of copper wire 32 feet long, each soldered along the flange of a piece of angle iron of the same length, and of sufficient cross section to be quite rigid when supported only at its extreme ends. At the end of each section is a watertight and airtight junction box with a heavy rubber top through which projects a pin adapted to be screwed to the end of an angle iron section and to support it in position.

The lower end of this pin in the box is provided with copper brushes that make contact with a copper plate below when depressed. The weight of the section, however is not great enough in itself to force it downward and it is kept by the air pressure in the box and by the elasticity of the rubber top from completing the circuit except during the passage of the car. The feeder is wholly insulated and all connections are made within the boxes. The car carries a double trolley making contact with one section of conductor before that with the last is broken, in order to minimize the tendency to sparking.

An experimental road is nearly finished and public exhibitions of the system will soon be given.

MISCELLANEOUS.

FOUR THOUSAND NEW YEAR GREETINGS BY TELEPHONE.

A very interesting demonstration of the possibilities of the telephone was made at St. Louis, Mo., on New Year's Day, when with the help of Mr. G. F. Durant, of the Bell Telephone Co., the *Globe-Democrat* called up all the telephone subscribers to wish them a happy New Year. There are three telephones in the business office of the *Globe-Democrat* for the accommodation of advertisers. For this occasion this number was re-inforced by seven instruments, which were placed on the fouth floor of the building. Supt. Durant personally superintended the New Year's calling, which was at the same time a practical test of the efficiency of the telephone service. That it might be the more satisfactory in the latter sense, no special provision was made for the reception and transmission of messages at the central office. The regular list of telephone subscribers was divided into ten portions, in alphabetical order just as printed, and a portion given to Messrs. Berger, Massey, McDonough, Walsh, Fluett, Parker, Lewis, Foster, Farrell and Wolff. The calls were made in accordance with the prescribed rules of the company, which are printed, framed and hung up at the side of every instrument in the city. Half a minute was allowed each station called for to respond before the number was checked off as not answering, and the next number on the list was then taken up. The electric calls were then commenced at 8.30 a. m., and the last of the greetings had been delivered at 11.58.

The best results were achieved by Mr. McDonough, of the telephone corps. He called up 514 stations in three hours and twenty-seven minutes, secured 260 answers, found fourteen busy, five out of order, and 235 not in use for the day. The whole time occupied in the transmission of the messages was thirty-three hours and eight minutes; the average time of each operator was three hours and nineteen minutes, and the average rate was 118 calls per operator per hour, a little the fastest thing in New Year's calling on record.

The following official record was compiled from the individual operative reports by Gen. Supt. Durant:

Station.	Operator.	Started.	Stopped.	Time occupied.		No. of stations called.	Answered.	Reported busy.	Reported out of order.	No. of stations from which no answer was had.
				H	M					
1960	Berger	8:30	11:55	3	25	380	225	20	4	131
1963	Massey	8:40	11:53	3	13	323	166	18	9	130
1965	McDonough	8:30	11:57	3	27	514	260	14	5	235
1966	Walsh	8:35	11:58	3	23	387	232	4	11	140
3985	Fluett	9:20	12:10	2	50	356	154	16	8	179
3986	Parker	9:20	12:15	2	55	373	139	5	1	228
3987	Lewis	8:45	12:25	3	40	363	178	11	8	166
4183	Foster	8:30	11:55	3	25	351	192	15	2	145
4186	Farrell	8:30	12:05	3	35	321	175	10	16	120
4199	Wolff	8:40	11:55	3	15	364	234	31	3	96
	Totals			33	8	3735	1954	144	67	1570

Mr. Durant in discussing the service was very much pleased with the result. There are always a number of telephones reported out of order on New Year's morning, the result of injury to the wires by flying bullets, fired by celebrants of the new year's birth. The general suspension of business in professional and commercial circles accounts for the large number of telephones not answering.

AN EXPERIMENTAL SEARCH LIGHT FOR SANDY HOOK.

The great search light from the roof of the Manufactures and Liberal Arts Building at the World's Fair, forming part of Schuckert & Co.'s exhibit, has been sold to the United States Government, and will be set up at Sandy Hook for experimental purposes.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.
Westen Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.
United States and Canada, - - - - - - - - per annum, $3.00
Four or more Copies, in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* The Electrical Engineer. *Communications for the attention of the editors should be addressed,* Editor of The Electrical Engineer, 203 *Broadway, New York City.*

Vol. XVII. NEW YORK. JANUARY 24, 1894. No. 299.

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THE NATIONAL STATISTICAL ASSOCIATION.

We have received a prospectus of The National Statistical Association, organized under the laws of Congress for the District of Columbia. The Association will undertake a service that is much needed by all public service corporations. The work of the company will include the collection, recording and tabulation of such legislative, legal and statistical information as may, from time to time, be found most useful to its clients, and the furnishing of such information to them at stated periods. The companies likely to be specially interested in this service are electrical and gas lighting companies, water companies and street railway companies. The work and business of The National Statistical Association will be under the personal direction and supervision of Mr. Allen R. Foote, Vice-President and Manager. Mr. Foote has made himself well and favorably known in electrical circles through his writings on industrial topics and as sometime Secretary of the National Electric Light Association. His book on The Law of Incorporated Companies Operating Under Municipal Franchises, which was reviewed in The Electrical Engineer of August 23, 1893, has received favorable notice and commendation from many competent sources. The forty-six associate editors of that work, attorneys in the several states, will, for the most part, be retained in the service of the Statistical Association. In addition to the collection, and supply of statistical information, it is proposed to keep watch upon all state and municipal legislation, effected or proposed, enacted franchise corporations and to report all litigation concerning such companies. It is obvious that the service about to be undertaken by the National Statistical Association directly concerns the interests and future welfare of all electric lighting and power companies. There is a distinct community of interest, or should be, among such corporations, and their adequate support of Mr. Foote's enterprise could not fail to benefit them as clients of the Association.

BI-METALLIC CONDUCTORS.

The article in our issue of Jan. 10 on the use of bi-metallic wires in telephony has created widespread discussion not only in telephonic circles, but in others as well. We publish in this issue a communication from Mr. A. N. Mansfield on the same subject. In the lecture delivered by Dr. M. I. Pupin before the New York Electrical Society last week on "Electrical Resonance," reference was also made to the bi-metallic wire. In both the above instances the authors, though expressing themselves guardedly, point out that theoretically at least there ought to be a gain in the use of such a wire. It is also brought out that greater benefit would be obtained by putting the iron on the outside of the copper instead of employing it as a core. Thus far the discussion has been confined to the influence of such a wire on telephone and telegraph lines only, but would it not be worth while to inquire also what influence such a conductor might have on long distance alternate current transmission? It is true that the rate of alternation for power transmission purposes averages far below that prevailing in telephony, but that even with this comparatively low frequency line difficulties are encountered, which become serious when long distances are attempted. The addition of iron to the circuit in all these cases affords a means of adding a self-inductive medium to the circuit, but what is of most importance, a *distributed* self-induction. What effect the employment of such a conductor might have on submarine cable work can hardly be foreshadowed as yet. It would be well, however, not to jump at conclusions as to the all-sufficiency of self-induction in neutralizing the effects of capacity on telegraph and cable lines, even though that self induction be distributed over the whole line. For, while capacity may successfully overcome the effects of self-induction, it does not follow that the reverse holds true in all cases ; and the many futile attempts to improve the speed of telegraph and cable working should invite to caution. Nevertheless we believe that the bi-metallic conductor is well worthy of the most searching study and presents the most promising improvement which has been suggested for some time past.

UNDERGROUND RAPID TRANSIT FOR NEW YORK.

There is distinct merit in the plan which has been proposed by R. T. Wilson & Co., bankers, for an underground electric road in New York city. They offer to build a double-deck road within four years if the city will lend two-thirds of the cost, or, in other words, a sum not to exceed $30,000,000, the city to have in return a first lien for reimbursement. We do not see the particular necessity or desirability of a double-deck system, believing the Greathead direct, individual tunnel method to be better with occasional interlacing of routes; but there is a distinct advantage in going below all existing pipes and subways on the line of Broadway. The road is to pierce the centre of the city, and by so doing will relieve the present serious congestion on the Elevated, besides building up a large new traffic of its own. The practicability of electricity is no longer in question, and all that the citizens of New York now ask for is prompt action.

THE LIMITATIONS TO LONG DISTANCE TELEPHONY.

In this issue we bring to a close the excellent series of articles by Mr. F. W. Dunbar on the above subject. The conclusions arrived at by the author are of a decidedly interesting and important character and show that so far as land lines are concerned, nothing stands in the way of doubling the distance of transmission already successfully accomplished, except the cost, which in that case would entail an eight-fold increase with copper wires. In how far the substitution of a bi-metallic wire would modify this estimate remains to be seen, and it will probably not be long before we will have some practical demonstration on this point. But there is another point dwelt on by Mr. Dunbar which merits attention and which is here brought out for the first time, and that is, the poor regulating qualities of the transmitter induction coil and its effects on the transmission. Much has already been done to adapt the induction coil to better telephonic working but evidently much more still remains. In view of the fact, according to Mr. Dunbar, that the coil on the New York and Chicago line actually furnishes a difference of potential of only two or three volts it seems pertinent to inquire whether better results might not be obtainable with the use of very low resistance storage batteries used directly without the intervention of the induction coil. We are well aware of the steadying action of the induction coil on the telephonic current impulses transmitted, and its influence in maintaining and even enhancing the sharpness of the curves, but it does not seem improbable that an equivalent effect might be obtained by employing other means than the non-regulation induction coil. These questions and many more will without doubt occupy the attention of investigators and inventors in the near future.

NO GOOD BLOCK SIGNALS.

It is rather a curious coincidence that just as the New York Central should get its fine new interlocking and block signal system into operation all the way from Manhattan Island to Niagara Falls, the Delaware, Lackawanna & Western Road should have a frightful accident, in the fog, due entirely and solely to the absence of a block system. The New York Central, with a magnificent disregard of mere expense, has put in no fewer than 1,633 levers with 108 signal bridges, and 60 signal towers. Yet President Sloan of the D., L. & W. has the infinite presumption or marvelous ignorance to rise and say that no block signal system can be depended on and that no system is perfect; ergo, railroads must depend on tired men and little red flags. Either Mr. Sloan impeaches the New York management or he impeaches himself by such statements. He can take his choice. The New York Central has at least the approval of all electricians and railroad men, and their opinions will have some weight with the public. It is the duty of any conscientious management of a road to reduce the chances of accident to a minimum, and to this end it must use every possible appliance of safety, even if it be expensive and even if it be a trifle short of absolute, inerrant infallibility. All Mr. Sloan has to do is to get the best.

POWER UTILIZATION SCHEMES.

The great and eminently feasible project of power transmission at Niagara is finding many rivals and imitations of a more or less visionary nature. As the discussion at the Institute meeting on Wednesday last showed, polyphase current power work is already being developing in a healthy manner, but the pace is hardly fast enough for those who want something big. Of course in days when such vast engineering works as the Manchester Canal, with its thirty-five miles costing $80,000,000, are carried through successfully, there is a ready faith in enterprises merely because they are big, and of that class the scheme of which we make note in this issue for the electrical utilization of the currents in the Irish Sea, by means of a huge causeway with flood gates, is perhaps the most conspicuous. We invite attention to the scheme not because of its feasibility, but because of the curious problems involved in such an attempt and because of the very curious results of all kinds that might follow.

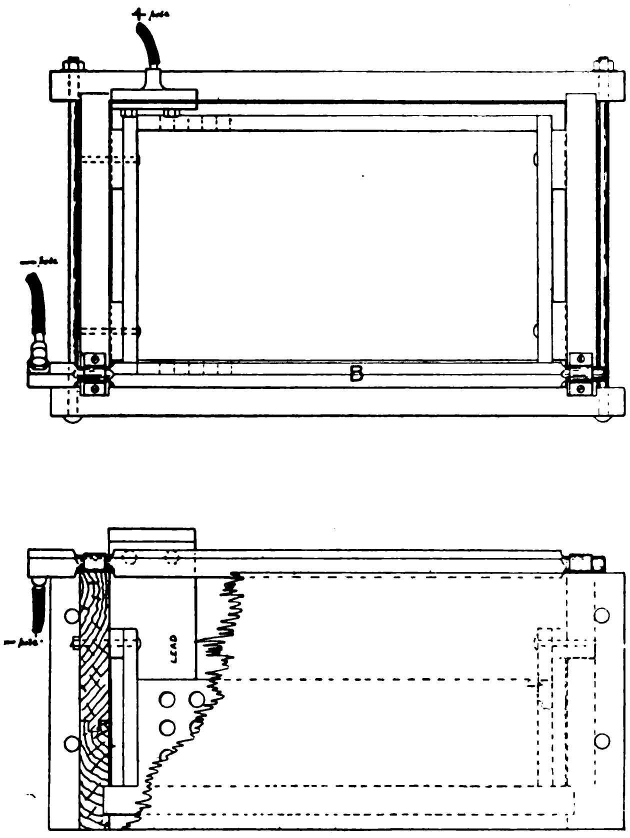
THE ELECTRIC LIQUID METAL HEATING PROCESS.[1]

BY GEORGE D. BURTON.

THE speaker stated that the process consisted in immersing the metal, or that portion to be heated, in a liquid, and passing through both an electric current of such a character as to cause the formation of an incandescent gas envelope at and below the surface of the solution and around the metal. The liquid best suited to the purpose he had found to be a solution of carbonate of soda and borax, composed of ten parts of soda and one of borax, having a specific gravity of 1.25 at 74 degrees Fahrenheit. This does not injure the material heated, but on the contrary, improves it, when the parts are afterward subjected to pressure.

A receptacle, composed of wood, earthenware or other insulating material, shown in Fig. 1, 2 and 3, contains the liquid, and a plate of lead is placed in the bath and serves as an anode, being connected, by means of a conductor, with the positive pole of a direct current generator of either 110, 220, or 500 volts, and from 6 amperes upward, varying according to the size of piece it is desired to heat. The size of the piece to be heated governs the amount of current consumed, and acts as the regulator, there being no other means of regulation employed. The receptacle may be provided with a lining of lead, if desired, and made to act as one pole. It also can be made of iron, or other metal, and made to serve in a like capacity. The negative pole in this case, would form a rest outside of the receptacle for the piece to be heated. That portion of the piece which is submerged in the bath will commence to heat as soon as it touches the bath, the circuit being closed through the anode and bath. An envelope of incandescent gas is instantly formed around the submerged portion of the metal and constitutes a voltaic arc surrounding the metal on all portions below the surface and separating it from the solution. When the workman observes that the piece has attained the proper heat, it is subjected to the forging or welding operation.

Bars of different sizes may be heated in the same bath up to the capacity of the circuit conveying the current. The passage of the current into the solution seems to transform it from a high tension and low volume to a current of large volume and low tension. Two bars may be held in contact and one receive current from the other. An incandescent gas envelope will be formed around these portions which are submerged below the surface of the solution, and the bars may be welded together in the bath by simply bringing the pieces in contact with each other.



FIGS. 1 AND 2.—PLAN AND LOGITUDINAL SECTION OF TANK.

Experiment has shown that when the working circuit is constant at 220 volts and the specific gravity of the liquid is at 1.15 and small pieces are to be heated, the size of a four penny nail, the amperage recorded will be five and the voltage will remain constant at 220, and, as the size of piece to be heated is increased the voltage will decrease and the amperage increase. In heating a piece three inches long and one inch square, the voltage will be reduced from 220 to 180, and the amperage will be increased to 98, showing that the piece governs the current required to heat it. A transformation of the current takes place in the tank when the piece is immersed, and shows a consumption of a trifle over 23 h. p. for 40 seconds for this size, when the liquid has a specific gravity of 1.15. The operator can hold the upper ends of the bars in his hand unprotected, as the current only passes through the lower portion between the rest, which form the negative terminal, and the solution, the bar taking off from the line more or less current, according to the volume required to effect the heating.

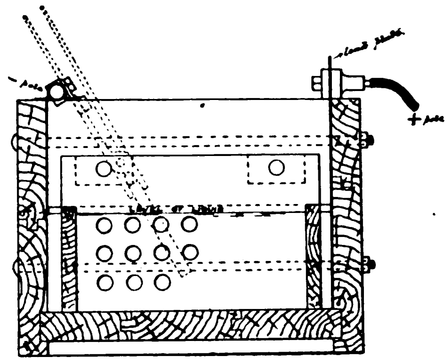


FIG. 3.—VERTICAL SECTION OF TANK.

In general practice automatic clamping devices are used which are connected to the negative pole. This pole, which is a substitute for the support, is fastened near the edge of the tank containing the liquid, and, while the workman is forging or welding one or more pieces, other pieces are being heated, the bath performing all the functions usually required about an ordinary forge.

Among the many advantages derived from the use of this system is its employment in connection with apparatus already installed for the purpose of electric lighting. A large percentage of the manufacturing establishments use an electric light plant. During the day, this apparatus, which remains idle, could be utilized for producing current sufficient to operate this liquid heating process, which can be installed without additional expense, except for the tank, wires and switch, thus affording an apparatus capable of continuous use, heating metals during the day and producing light at night.

THE THEORY AND DESIGN OF THE CLOSED COIL CONSTANT CURRENT DYNAMO.[1]—I.

BY PROF. HENRY S. CARHART.

THE speaker stated that it was not his purpose to draw any comparisons whatever between opened and closed-coil armatures; the former, he said, is entitled to that consideration which long continued and satisfactory service in public and private illumination had earned for it, but the latter is making its way into public favor, and it has certain peculiarities which make it an interesting subject for study. If he were to draw attention in this paper to comparisons between dynamos of different type, it would be between those for [illegible]t potential and those designed for constant current, both [illegible]osed-coil armatures. For in almost every particular the la[illegible] is diametrically opposite to the former.

He then called attention to a number of points of dissimilarity between the two types, assuming that the speed be constant in both cases.

THE NEUTRAL PLANE INDEPENDENT OF THE PLANE OF COMMUTATION.

By neutral plane is meant a plane passing through the axis of the armature and so situated with reference of the poles of the field magnet that when a coil of the revolving armature is carried across it the E. M. F. generated changes direction. This plane intersects the armature in a straight line, but it may broaden out more or less into a surface of small lateral dimensions.

The plane of commutation is a plane passing through the armature axis and the points of contact of the brushes on the commutator. It is the plane joining the poles of the armature considered as an electro-magnet. This latter plane, of course, shifts with the brushes, since the poles of the armature are the points at which the current enters and leaves the armature, and these are necessarily the points or surfaces of contact of the brushes with the commutator, assuming that the connections from the armature to the commutator run directly out parallel to the shaft. To state the proposition now under discussion in the form of a question, Does the neutral plane shift when the brushes are shifted forward or backward? If we were to make answer from the assumption that the resultant of two impressed magnetizations or magnetomotive forces may be obtained in the same manner as the resultant of two forces by means of the triangle of forces, we should probably conclude that the neutral plane rotates forward with a forward movement of the brushes. But experiment along several different lines shows that this conclusion is erroneous. If we were to apply to the solution of this problem the principles derived from constant potential machines we should be forced to the conclusion that, to maintain sparkless commutation at the brushes, the lead of the brushes beyond the neutral plane should be constant, since the current remains constant; and therefore that any attempt to govern for constant current by rocking the brushes must be attended by destructive sparking, unless at the same time the field is greatly modified. But these conclusions are also erroneous. We must therefore first establish the facts and then make a theory to fit them.

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[1] Abstract of a lecture delivered before the Franklin Institute, Philadelphia, Jan. 17, 1894.

[1] Abstract of a lecture delivered before Electrical Section of the Franklin Institute Tuesday Dec. 26, 1893.

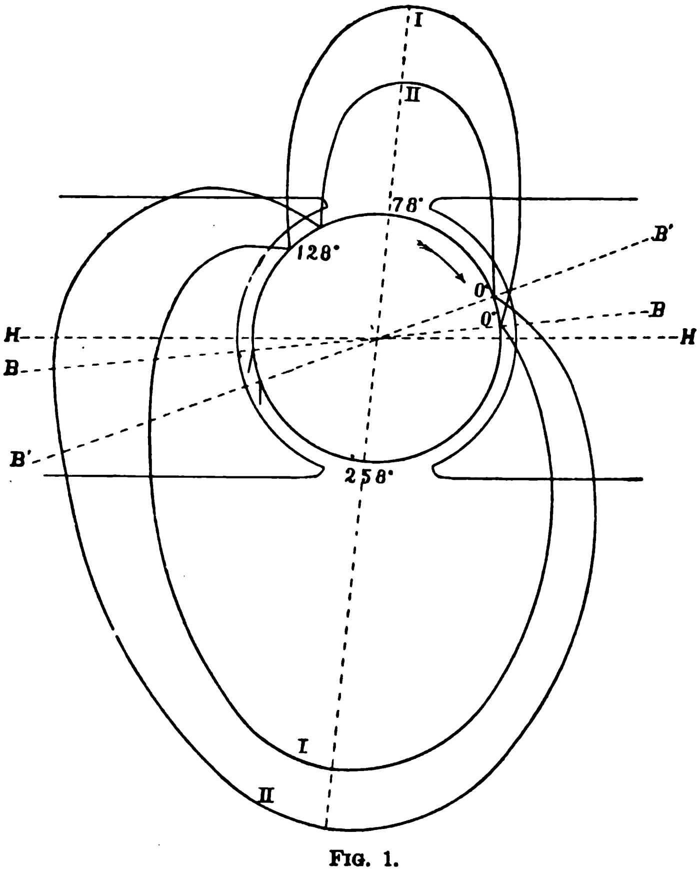


FIG. 1.

The fixed position of the neutral plane I have determined on a ten-light machine in two different ways.

First Method.—Four turns of No. 16 silk covered magnet wire were wound around the armature ring as an exploring coil. One end of this coil was soldered to a copper band or ring fastened on the commutator and insulated from it by several thicknesses of mica. The other end was soldered to a piece of brass let into a fibre collar placed around the commutator. One extra brush was fastened to one of the main brush holders and rested on the copper band. The other extra brush rested on the fibre collar and could be attached to any point of a circular scale made concentric with the commutator. A twisted cord ran from these two brushes to a telephone at some distance. When the dynamo was running, the movable brush, which rested on the fibre and made contact with the brass strip every revolution, was moved around the circle till a minimum sound was heard in the telephone. The exploring coil was then on the neutral plane at the instant when the brush made contact with the strip. Motion of the brush either way caused the sound to increase in loudness. The position of the exploring coil for minimum sound was to be found about 5 degrees in advance of the normal plane intermediate between the pole pieces; and its position did not change from full load to no load as far as could be detected by this method.

Second Method.—To the brush holders was attached an insulating ring slotted on the periphery at every ten degrees on a milling machine. It was made as nearly concentric with the commutator as possible. A third brush holder was placed in the successive slots, and the potential difference between it and one main brush was measured in its several positions. These measurements gave the integrated P. D. between the main brush and successive points on the commutator all the way round the circle and back to the starting point. This was done with no load or nearly short-circuit, with a load equivalent to three lamps, and finally with a load equivalent to nine lamps, the current being ten amperes in each case. The results in the first two cases are plotted round a circle in Fig. 1. Positive values, or those in which the potential of the third brush was higher than that of the main positive brush, are set off outside the circle in the upper part of the figure; while negative values are set off outside in the lower section of the diagram. The direction of rotation is clockwise. With no load the highest positive potential was about 78 degrees behind the positive brush. From this point it fell again, and at 128 degrees it was the same as that of the positive brush. For all the coils between 0 degrees and 128 degrees the integrated positive and negative E. M. F.'s. exactly equal each other. The neutral plane falls evidently 78 degrees behind the brush, or the brushes may be said to have a lead of 78 degrees with no increase in sparking. A negative maximum occurred at about 260 degrees and the P. D. between the positive and negative maxima was 644 volts. The same P. D. was found by direct measurement when two extra brushes were set at these points.

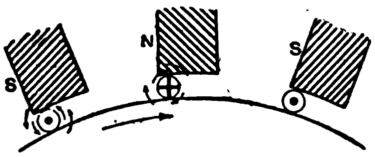
With a load equivalent to three lamps the brushes were rocked back 15 degrees to bring the current to ten amperes. Hence the zero of this curve begins 15 degrees back from the zero of the first curve. Again the observations are plotted and the positive maximum falls at the same place on the circle and therefore at the same place on the commutator. The two maximum points are about 65 degrees and 245 degrees from the positive brush and the two potential differences are 163 and 456 volts. Their sum this time is 624 volts, a little less than with no load. With the highest load carried the brushes were rocked backward about 50 degrees further and the lead was then about 15 degrees. The extreme P. D. obtainable this time did not exceed 600 volts. So far as can be discovered from these curves the neutral plane remains fixed, while the brushes move round the commutator to adjust to a constant current. I find no evidence in them that the forward movement of the brushes to control the current causes the neutral plane to move with them. As the brushes advance with a diminishing external load they put between them and the neutral plane an increasing number of armature turns generating counter E. M. F.; and it is a striking fact that, when the field coils are not cut out, the back turns on the armature cut down the P. D. between the brushes not by a counter magnetomotive force apparently, but by counter electromotive force; for the maximum P. D. to be found on the commutator is no less on no load than on full load, showing that at least as many lines of force traverse the armature core with the brushes far forward and with many back armature turns as with the brushes in the position for the maximum load and with the back turns reduced to a minimum.

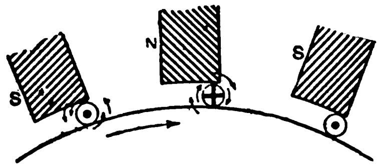
THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—VI.

BY PROF. GEORGE FORBES.

MR. GISBERT KAPP said there was one point which struck him on reading the Paper for the first time, where the author was discussing the merits of the number of phases, whether they should have a single phase or two or three phases. When he (Mr. Kapp) was in America in the summer he had a long talk with Prof. Thomson upon this subject. He was very hazy at the time, he must confess, and Prof. Thomson tried to convince him that three phases would require less copper than two. He could not see it then, but he had since studied it, and read all that Dobrowolski and others had written on the subject, and at last he could see light. The result of his investigation was this: Suppose they found the copper in the line weighed 100 tons when a continuous current was employed. If they now worked a different line with the same length and the same efficiency of transmission and the same stress on the insulators with an alternating current, they would double the copper, which would now weigh 200 tons. If they used two phases with four wires they would again require 200 tons; but if they thought to save copper by using only three wires and working two-phases they would require 290 tons, so that the system which Prof. Forbes recommended as the most economical in copper was actually the worst. If they now had three wires, and worked at three-phases, they would use 150 tons only. Two-phase working with three wires was out of the competition altogether; it was too expensive. As regards the motors, he had again the misfortune to differ from Prof. Forbes. The latter thought the low-frequency motor would be more efficient, and at the end of his Paper a calculation was given to show that the losses in the high frequency motor were 42 per cent. greater than in the low frequency. He quite agreed with the 42 per cent., but he was afraid Prof. Forbes had overlooked the fact that with the high frequency they would have to supply two and a half times the electromotive force, and it would give two and a half times the power, and, consequently, what appeared to be an increase in the loss of 42 per cent. became actually a gain of 33 per cent., so that on his own showing the high frequency was the more efficient. One reason which Prof. Forbes has given for the use of low frequency, and which had appealed to him (Mr. Kapp) very strongly, was that you could make a synchronizing motor out of any dynamo. If they wanted to rig up a motor quickly they could go and buy a dynamo and set it to work. But when he began to consider what had to be done he saw that it was not so simple. They had to put on two contact rings to begin with. Dynamos were cut very fine nowadays; makers did not give extra room for fancy fittings. Therefore they had to send it out to be fitted with these things by a maker. Supposing they had done this, how were they going to start it? Being a single-phase motor, it would not start by itself, and they must put down a little Tesla motor, or some other, to start it. And if they did that they might as well use the Tesla motor a little larger and run their factory from it. He would like to point out that single and multiphase alternate-current motors were on the market and were very good. The only reason that the impression prevailed in England that they were not to be had, that they were not reliable, and only experimental, was that they placed too much credit on what appeared in the electrical papers. He was afraid the papers were treating them rather badly in this respect. It was the fashion amongst them to cry down multiphase and alternate-current work. He could quite symphathize with the editors; it was an unfortunate thing that they had to take up new subjects and study them in order to write intelligently about them. The ordinary alternating current was bad enough, but when you came to three phases it was really too bad. But they should not cry down these things; let them state what the facts were. He had tested such a motor made by the Oerlikon Company, with the following results: the machine gave on the brake 862 watts, and it ran at a speed of 1,800. The frequency varied from 60 to 67; the commercial efficiency was 60 per cent.; the power factor was 74 per cent.; and at starting the current to produce a torque equal to that at the full output of 1¼ h. p. was 2¼ times the normal working current. It was rather inconvenient to have such a large current at starting, but by a very ingenious arrangement, now used all over the Continent, the mains did not feel this large current. There was an auto-transformer with a switch handle, which, at the expense of pressure, gave the extra current which went into the motors, and it worked beautifully. The weight of that machine was under 1cwt. per horse-power. There seemed to him to be very strong reasons against the adoption of low frequencies as regards motors, and perhaps not so great, but still sufficient, reasons as regards the transformers; one very strong reason was the cost of the alternator. He had studied the design of Prof. Forbes's alternator very carefully, and he might say at once that he was very pleased to be able to agree with him that it was about the best machine that could be made for the job.

Prof. Silvanus Thompson said that the Paper bristled with points, but he would confine his remarks to one or two. In the first place some rules concerning parallel working were given, or rather some remarks were made about the knowledge, or want of knowledge, upon that which constituted the successful design of machines for working in parallel. Prof. Forbes said: "The rules which govern the construction of machines which shall work well in parallel are not very clearly understood. The only fact which has been perfectly established in practice is that the lower the frequency the more efficient and sure is the parallel working." He, too, felt disposed to dispute this point. He would not dwell upon it—he simply disputed it; it had not yet been established; it might be true, but it had not been established. But he did venture to think that this was not the only fact bearing upon the question of the construction or the design of machines for parallel running. In the first place they knew perfectly well that machines would not run well in parallel if they had weak field magnets, if they had armatures that, with the output that the machine was designed for, would perturb or interfere with the magnetism of the field in any serious way. Further, they knew that they did not get easy working between two alternators of distincly different types. In this case, if the two alternators were so designed, whether in the placing of their coils, or the shape of their pole-pieces, or the relative positions of coil and pole-pieces, so that the curves of their induction were widely different, one giving a form nearly like a sine curve, and the other giving a curve like a saw-tooth curve, they would not run in parallel. These were points that really were known, and bore largely on the question of design. Further, he would like to point out that they sometimes spoke of the self-induction in the armature, and of the reaction of the armature, as though they were the same sort of thing. There was no doubt whatever that an armature which had no iron in it, or in close proximity to it, would have less self-induction and armature reaction than an armature that had much iron in it, and that iron in close proximity to the coils. But they might have an armature which had much self-induction without necessarily very much armature reaction. It depended upon how the iron was disposed near the armature coils with respect to the approach to the polar parts, and the thing which was disastrous in the design of an alternator for these purposes was the putting of iron into the armature in such a way that the iron acted violently on the magnetism, and pulled it about so that the field became an unsteady one. All this, of course, was contained in those wonderful equations on the action of alternate-current machines which Dr. Hopkinson published about 1884. He (Prof. Thompson) was perfectly well aware that the whole theory of alternate working and parallel running could be dug up from those equations. But it was more to the point if they inquired what was the physical action which went on and made it easy or dificult for two machines to run in parallel when they were placed on the same circuit; and the physical effect was really easy to follow out if described by means of a diagram. If they took one of the ordinary types of alternator, say, for example, the Westinghouse (see diagram). Suppose the armature core to be rotating right-handedly, and they had the wires on the outside, the tendency would be to generate currents which would come toward them as the wire was passing the S pole, and to go away from them as the wire was passing the N pole. That was to say, the electromotive forces, everything being supposed to be symmetrical, would be at their maxima in those coils, and would die away to nothing exactly half-way between the poles. Suppose they had two such machines, exactly alike in phase with one another. Their electromotive forces were at a maximum at that particular instant, and if there was no lag in the current, no self-induction, they would have the currents also at a maximum at the particular point. Now, suppose they had those two machines coupled together in parallel, the electromotive forces were equal if other things were equal, and there was no tendency for one machine to send a current through the other one either way. Now suppose one was a little behind and the other a little ahead, then the electromotive forces would not necessarily be equal. The consequence would be that the current produced by the two through one another, would throw a load on the leading machine tending to bring it back, and a load tending to bring up the lagging machine. But now suppose that the current in the wires was capable, by reason of the disposition of the iron or anything else, of producing considerable reaction. Now for the receding current, the tendency was to exercise a magnetizing force around it which would strengthen the field in front of it, and weaken it behind. As a matter of fact, the question of strengthening the field in front of it, or weakening the field behind it, strengthening the field as a whole, depended upon whether the strengthening or weakening was a maximum when the coil was in front of the pole of the alternator or not. If the maximum was reached when the wire was behind the middle position it considerably strengthened the field, but if the maximum occurred when the wire was in front of the middle position it would weaken the field. The one that was ahead of the other would weaken its field, while the other one would strengthen its field. These two reactions, the one of strengthening, the other of weakening, precisely tended to defeat the tendency of the two machines to get back into parallel; that was to say, the back armature reaction would of itself tend to prevent the synchronism to parallel.





THE TELEPHONE IN GERMANY.

According to the *Zeitschrift für Electrotechnik*, the number of telephone stations in Germany, which was 1,504 in 1881, had increased at the beginning of this year to 68,558, of which Berlin had 17,424, with over 20,400 miles of lines. The interurban service is also increasing rapidly, and there were at the beginning of the year 316 long-distance telephones, with 14,280 miles of line, the longest direct line being that between Berlin and Breslau, nearly 200 miles.

LEGAL NOTES.

EDISON ELECTRIC LIGHT COMPANY v. DAVIS ELECTRICAL WORKS IN THE COURT OF APPEALS.—REPAIR OF LAMPS.

IT will be remembered that a few weeks ago Judge Colt, of the United States Circuit Court, District of Massachusetts, granted to the Edison Company an injunction against the Davis Electrical Works, of Springfield, Mass., for repairing incandescent lamps. The Davis Company at once appealed from this decision, and on Thursday, the 18th inst., a hearing was given before the United States Circuit Court of Appeals, District of Massachusetts, before Judges Putnam, Nelson and Webb. Messrs. Fish and Richardson acting for the plaintiffs, and ex-Judge Lowell of Boston and Mr. J. L. Roberts of Boston, for the defendants.

In opening the case Mr. ROBERTS, referred to the argument of the defendants, in saying that the cheapness of the lamp precluded it from any necessity for repairs, and that it was intended for the scrap heap when the carbon burned out. He combated this idea and said any company had a perfect right to repair its lamps, as they might and did burn out frequently before the guaranteed number of hours had expired. He then proceeded to ridicule the idea that the Edison Company's claim that when the Davis Company opened a lamp for repairs they destroyed the Edison vacuum, or vacuous space. The vacuous space was simply the shell of the lamp, containing nothing, and he did not think the Edison Company could claim the air, though they appeared to claim everything else. He stated that it was not true, when the defendants claimed that after the Davis Company repaired a lamp, they had a *new vacuum* (such a claim was ridiculous) a new globe and a new carbon. Not a piece of glass (saving the little tip on the bottom of the lamp) is taken away and not a piece is added, We have, he said, everything in the lamp to be repaired that was there originally, except the carbon,—the leading-in wires, the copper wires, the cap, the glass, everything is just as it was, except that we put in a new carbon to replace the one burned out. Judge Colt had allowed in his decision, that if the lamp were opened from the socket end and a new carbon put in, as in the original Sawyer-Man lamp, it would not infringe, and he asked the Court what the difference was if the Davis Company opened the lamp at the other end and put in a new carbon. Mr. Roberts, then, with the aid of a regular glass-blower's bench and the assistance of a workman, showed the Judges the precise operation of repairing a lamp as done by the Davis Company, and also by way of contrast the extra labor necessary in making a new lamp. He then went on to cite cases where the Courts had allowed parts of machinery to be repaired, as in ploughs where the tips wear out, planing machines where the cutters wear out, and others.

MR. FISH, then argued for the plaintiffs and commenced by saying that it was not possible for the Judges to judge intelligently without fuller knowledge of the Edison patent, and the state of the art prior to Edison's discovery. He claimed that the Edison invention was radically new, and many scientists had said that it was impossible to subdivide the electric light, until Edison showed them how. He then went on to explain the nature of Edison's lamp, the multiple arc system of distribution, Sawyer-Man experiments with carbons of rod, the introduction of nitrogen, the disintegration of the carbons, the discovery of Edison that a high resistance filament of small radiating surface was necessary, the great discovery of the air-washing effect, and all the necessary steps leading up to Edison's invention. "During all these years," he said, "no one ever tried to repair lamps; that process did not commence until after suits were commenced against infringers, and it was done simply to evade the patent. The Edison lamp distinctly took the place of the old lamps which were made to be repaired, and was made *as a whole*, each part having a definite relation to the other part, and was distinctly made in such a manner, that it was intended to be thrown away, after being burned up, and no one ever attempted to do anything else until this litigation arose. Mr. Fish also then cited cases where repairs were lawful, but claimed that these machines were so made, that it was intended from the first that the worn out parts should be repaired, and were totally distinct from the case in point, whereas the incandescent lamp was made as a whole and not intended for repair. In repairing the incandescent lamps, he maintained that the combination of the second claim of the Edison patent was broken;—the vacuous space disappeared, there was left no vacuum, no all-glass receiver, no carbons, nothing but the leading-in-wires, and he claimed the lamp when repaired was really and practically a new lamp. "How," he said, "is this like restoring knives, or repairing broken gears, or burned out grates in furnaces." "No," he claimed, "it is totally different." The question is "Is the identity of the machine maintained?" Then he went on to explain to the Court that even the voltage of the lamp repaired might be changed, nay, must be changed, as he claimed that it was impossible to replace a carbon of exactly the same voltage as the one originally in the lamp. He also claimed that the cost of repairing lamps was just about the same as the cost of manufacturing new lamps, and that therefore the repairing of lamps was entirely unnecessary. Mr. Fish then went on to explain to the Court that the plaintiffs were under contract with more than ninety licensees, who had the exclusive right to sell lamps in certain territories, and whom they were bound to protect. "The patent may expire in November, 1894," he said. "It will expire then as the law now stands, and in these last days of the life of the patent," he prayed that the injunction be granted, on the ground that the defendants by their claims were actually enjoying the protection of the Courts, which had maintained the Edison patent, and prevented them (the defendants) from making new lamps.

EX-JUDGE LOWELL, afterwards addressed the Court, and disputed the claim made by Mr. Fish that no repairs were made in lamps until after the commencement of litigation. The Davis Company did both, but stopped making new lamps, very soon after the first suits for infringement were brought, without the action of the Courts, as they were convinced that they would infringe the Edison patent, by making new lamps, as had been decided by the Courts. It was not a question of ease or difficulty of manufacture, or cost of repairing as compared with the manufacture of new lamps; it was whether the carbon was temporary or not. In a combination patent, every element is of equal value, he claimed, and if anyone could get along without one element of the combination, he would not infringe the combination patent. He claimed that preliminary injunctions were just as bad as final injunctions, in their effect on the company enjoined, and are sometimes refused for the same reason that Mr. Fish advanced for the granting of the injunction, namely, for the reason that the patent is about to expire. Judge Lowell then brought up an interesting point of law as to whether the Court of Appeals could reverse the decision of the lower Court, and the Judges allowed the plaintiffs ten days in which to file a brief relating to this point.

TERMS OF THE NOVAK STAY OF INJUNCTION.—EDISON ELECTRIC LIGHT CO. vs. WARING ELECTRIC CO.

THE terms of the stay recently granted by Judge Shipman in the "Novak" lamp case run as follows:

"The operation of the injunction shall be stayed until the 23d of January, or on such a day thereafter as the court of appeals shall first assemble and that this stay shall then "ipso facto" terminate unless the defendants have perfected their appeal and said case is ready to be called for argument in its due order as a preferred case on the calendar on that day and the defendants then stand ready to argue the same. In which case this stay shall continue until said appeal is decided by the appellate court. The above stay is granted on the condition that the defendants on or before Tuesday, January 16, 1894, file a good and sufficient bond in the sum of $10,000 with satisfactory securities to pay to the complainants any damages or profits to which they may be entitled because of the continuance of the manufacture by the defendants of the lamps alleged to infringe said patents in suit during the period covered by said stay."

A special dispatch of Jan. 18 from Hartford, Conn., says:—The Waring Electric Company of Manchester has filed a bond of $10,000, pending the appeal in the suit of the Edison Electric Light Company and others. The bond was executed by President Chapman. Clerk Marvin of the United States Court forwarded to Clerk Shields of the United States Circuit Court of Appeals, New York, all the papers, exhibits, etc., in the suit. The case will be argued Jan. 23.

EDISON ELECTRIC LIGHT CO. vs. E. G. BERNARD CO.—EDISON CIRCUIT PATENT LITIGATION.

In the United States Circuit Court at Albany, last week, Judge Coxe heard argument of counsel for and against the motion for a preliminary injunction in the action of the Edison Electric Light Company against the E. G. Bernard Company of Troy, N. Y., for infringement of the Edison feeder patent of 1882, in the use of a system of electrical distribution in the plant being installed at the Watervliet arsenal. Argument was concluded Thursday and decision was reserved. Judge Coxe also refused to issue a restraining order against the defendants in a suit between the same parties under several other patents, and gave the defendants three weeks in which to file answering affidavits. George A. Mosher of Troy appeared as attorney for the Bernard Company. The last case is a suit over an alleged infringement of the Bernard Company on six or seven electric lighting arrangements which the Edison Company claims to have originated.

The most important dispute is under what is known as the three-wire patent. The Edison Company petitioned the court to grant an order restraining the Bernard Company from using this patent. Mr. Bernard stated that the arrangement is under the patent of the Siemens & Halske Company of Berlin which antedates the Edison patents from two to five years. Judge Coxe has as yet rendered no decision in the matter of the request for a preliminary injunction against the Bernard Company from using the Edison feeder patent of 1882.

PROF. ROWLAND WINS HIS SUIT AGAINST THE CATARACT CONSTRUCTION CO.

THE suit of Prof. H. A. Rowland against the Cataract Construction Co. for $30,000, as a fee for his services in connection with expert work preliminary to the selection of plans and apparatus for the Niagara transmission was brought to a close on Jan. 20. Prof. Rowland's original bill was for $10,000. The company sent him a check for $3,500. He then brought suit for $30,000, based on a per diem charge of $150. The jury gave him a verdict for $9,000, making $5,500 in addition to the sum already paid. The case will be appealed. It was heard before Judge Shipman, with John S. Wise for the plaintiff and Joseph H. Choate for defendant. Many distinguished witnesses were called on both sides, including Frank J. Sprague, Dr. Louis Duncan, Wm. Stanley, Jr., Prof. George Forbes, Dr. W. W. Jaques, Prof. Barker, Dr. Coleman Sellers. The case attracted a good deal of attention. Mr. Choate tried without much success to belittle Prof. Rowland, but made the most of a remark in a private letter of the plaintiff that he was one of the first physicists in the world. It came out that Lord Kelvin and Dr. Hopkinson had only received $2,500 each for their services.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

AT the meeting of the Council of the Institute held January 17, the following associate members were elected:

Adams, Comfort A., Jr., Instructor in Electrical Engineering, Harvard University, 21 Stoughton Hall, Cambridge, Mass.; Bethell, U. N., Acting General Manager, The Metropolitan Telephone & Telegraph Co , 18 Cortlandt st., N. Y. City; Broadnax, Francis, Engineer, Safety Insulated Wire and Cable Co., 50 Broadway, New York City; Broich, Joseph, Superintendent and Electrician, with F. Pearce, 418 8th ave., Brooklyn, N. Y.; Ende, Sigfried H., Colonnade Hotel, 39 Lafayette Place, New York City; Flanagan, Thomas Francis, Supt. and Electrician, Portsmouth Gas Light Co., Portsmouth, N. H.; Flint, Bertram P., Electrical and Mechanical Engineer, with Chas. H. Davis, 120 Broadway, New York City; Knox, James Mason, Student in Electrical Engineering, Columbia College, School of Mines, New York City; Meredith, Wynn, Asst. Superintendent Operating, Electrical Dept., Midwinter Fair, San Francisco, Cal.; Osterberg, Max, Student in Electrical Engineering, Columbia College, 232 East 62d st., New York City; Selden, R. L., Jr., Deep River, Conn.; Sever, George F., Instructor in Electrical Engineering, Columbia College, 121 East 30th st., New York City; Smith, Charles Henry, Assistant Electrician, South Eastern Tariff Association, Atlanta, Ga.; Sprout, Sidney, Electrical Department, Midwinter Fair, San Francisco, Cal.; Wardlaw, George A., Assistant Engineer, People's Light and Power Co., Doolittle House, Oswego, N. Y. Total 15.

The following associate members were transferred to full membership: Emmet, W. L. R., Electrical Engineer, General Electric Co., New York City; Keith, Nathaniel S., Electrical Engineer, San Francisco, Cal.; Adams, Alton D., Worcester, Mass.; McCluer, C. E., Supt. First District, Southern Bell Telephone and Telegraph Co., Richmond, Va.; Jackson, J. P. Assistant Professor of Electrical Engineering, Penn. State College, State College, Pa. Total 5.

A report was made from Dr. F. B. Herzog, chairman of the Committee on revision of the rules recommending a few minor changes in the rules governing elections. Owing to the lateness of the hour, its consideration went over to the next meeting.

During the evening session of the 17th, Dr. Louis Bell presented an admirable paper on "The Practical Properties of Polyphase Apparatus," which was discussed by Messrs. Stanley, Steinmetz, Mailloux and others. The following report was presented by the Committee on Units and Standards:

Your Committee on "Units and Standards" begs to recommend to the Institute the provisional adoption of :—

The term "gilbert" for the C. G. S. unit of magnetomotive force, the same being produced by 0.7958 ampere turn approximately.

The term "weber" for the C. G. S. magnetic unit of flux sometimes described as the C. G. S line of flux.

The term "oersted" for the C. G. S. unit of reluctance

The term "gauss" for the C. G. S. unit of flux density, or one weber per normal square centimetre.

The Committee, it will be remembered, in its previous report, dated June 20, 1891, advocated that the above terms should be accorded to magnitudes in conformity with the "practical" electromagnetic system, and therefore following in natural order and extension from the volt, ohm, ampere and other units in universal use.

As, however, so important a series of new unit magnitudes could only meet with general recognition and favor under the authorization of an International Electrical Congress, which authorization has been withheld at the recent Congress at Chicago, and since objections have been raised to those magnitudes, your Committee considers that the urgent need for names specifying the principal quantities dealt with in magnetic circuits can best be met with general favor, by adopting for those names the fundamental unit magnitudes of the international C. G. S. system after the precedents already established in the cases of the C. G. S. units of force and work, entitled respectively the "dyne" and "erg."

F. B. Crocker, W. E. Geyer, G. A. Hamilton ; A. E. Kennelly, Chairman.

The report of the Committee on being put to vote, was not adopted.

ANNUAL MEETING OF THE NORTHWESTERN ELECTRICAL ASSOCIATION.

THE annual meeting of the Northwestern Electrical Association was held at Milwaukee on January 17 and following days. A brief but excellent programme of papers was discussed. The names of those in attendance are as follows :

Herman Andrae, L. V. Gibbs. M. H. Johnson, W. Goltz. Mayor H. C. Koch, H. D. Goodwin, O. D. Kleinsteuber, James Motley, S. G. Coleman, R F. Kountz, M. L. Stevenson, O. M. Rau, Milwaukee, Wis.; F. Overbaugh, H. D. Latimer. Geo. Mayo, W. D. Ball. D. S Terry, A. C. Bunce, W. J. Ferris, W. C. Wheaton, W. W. Low, S. F. B. Morse, G. S. Whyte, Fred. De Land, W Forman Collins, F. N. Boyer, P. J. McFadden, Chicago: W. B. Baker, J. P. Lord, Waupaca, Wis.; Pliny Norcross, Janesville, Wis.; C. C. Paige, Oshkosh, Wis.; E. L. Dubell, Sheboygan, Wis ; H C. Thom, Madison, Wis.; John Shulte, Manitowoc, Wis.; John Wiley, Hancock, Wis.; Carroll Collins, Green Bay, Wis.; M. L. Stevenson, Cleveland, Ohio; W. H. Thorpe, Beaver Dam; J. Earle, Kaukauna, Wis ; T. G. Grier, J. A. Berkley, Little Falls, Minnesota; C. A. Spencer, Centralia, Wis., G. L. Cole, Beloit, Wis.: H. Amundson, La Crosse, Wis.; E. Engrebreton, Whitewater, Wis.; M. A. Burt, Baraboo, Wis.; C. D. Johnson, Tomah, Wis.; T. F. Grover, Wawautosa, Wis.; J. H. Trever, Antigo, Wis.; J. A. Andrews, Hudson, Wis.: G. F. Merrill, Ashland, Wis.; D. C. Jackson, Madison, Wis.; Geo. Grimm, Jefferson, Wis.; E. K. Patton, Boston.

The officers elected for the current year are as follows :

President, C. C. Paige; 1st vice-president. W. B. Baker; 2d vice-president, E. L. Debell; secretary, H. C. Thom; treasurer, G. F. Merrill; directors, W. Goltz, Pliny Norcross, John Shulte.

THE ELECTRICAL WORKERS' LECTURES.

THE UNIVERSITY EXTENSION LECTURES on Electricity arranged and undertaken by the Electrical Workers of this city, under the supervision of Columbia College, have proved an instantaneous success. The course opened at Cooper Union on Monday, January 15, when Mr. C. O Mailloux delivered an excellent lecture on "Batteries," illustrated with practical batteries and examples. The attendance cannot have fallen far short of 500. A large number of persons were unable to get into the hall, and standing room was not to be had. The lecture was followed with the most intelligent interest and with a ready appreciation on the part of the audience of its important points. The lecture to follow on Monday evening (Jan. 22) by Dr. Louis Bell on "Alternating Current Dynamos and Motors" promises to prove not less attractive and instructive. The trade organization which has thus lent its powerful support to educational work among its own members and the public is entitled to all praise.

THE FRANKLIN ELECTRICAL SOCIETY.

A RECEPTION and banquet were given by the Franklin Electrical Society, on Saturday evening, Jan. 6, at the Columbia, this city, in commemoration of Benjamin Franklin. The hall was decorated with the Society's colors, and all those who were present, voted it a great success. Mr. W. W. Ker, toast master, introduced the various speakers of the evening, among whom were Mr. E. V. Lallier, president, Mr. Max Mayer and Mr. Arthur Hammerschlag. Mr. Newton Harrison read a very able and interesting "Eulogy on Benjamin Franklin"; and Mr. Louis Wasself entertained the guests with an amusing paper on "Electrical Terms and Phases."

REVIVAL OF THE DRAWBAUGH TELEPHONE.

AN ordinance has been introduced in the Philadelphia Common Council granting permission to the Drawbaugh Telephone and Telegraph Company of Philadelphia, which was recently organized with a capital stock of $3,000,000, to construct and operate a system of wires and cables within the city limits. This action is the beginning of an effort to introduce a rival telephone service upon the expiration on January 30, of the Bell Company receiver patents.

ERRATUM.

IN the article entitled "The Telephone Patent Litigation," begun in our issue of Jan. 17, an error crept in regarding the number of the Phelps patent (page 45, eighteen lines from the top of first column). The number should read 220,209, instead of 222,201, which refers to the Phelps support switch patent.

LETTERS TO THE EDITOR.

ELECTRIC LIGHTING AND INSURANCE RATES.

The writer has been engaged for some time in ascertaining how many fires have been charged against the electric lighting interest in this city since the beginning of the filing of reports as to the cause and origin of fires, and having ascertained that electric lighting has had less fires assigned to it than any other, he deemed that it might be of interest to the readers of THE ELECTRICAL ENGINEER to give a list of fires as charged to the different methods of illumination, viz., kerosene oil, gas and electricity; and also a list of those fires charged against matches and general causes, making five specific headings against which fires are charged in this city.

	1888	1889	1890	1891	1892	1893
Kerosene Oil.....	181	174	144	248	294	371
Gas..............	62	110	116	151	200	194
Matches..........	31	65	90	116	193	187
Electric.........	9	33	23	20	34	31
General	1075	1472	1650	1849	2118	2103

In looking over the list you will notice that kerosene heads the list (outside of the general causes), gas coming second, matches third, and electricity fourth. The writer would invite your attention and that of your readers to the fact that when the cause and origin of a fire is attributed to kerosene oil or gas, 99 per cent. of the charges are correct, inasmuch as it is possible to show that kerosene oil or gas have caused the fires for which they are charged, as any fire originating from either of these causes is so evident that no doubt is left in the minds of the Fire Patrol or Fire Department as to the origin. In the case of matches there is, we must admit, considerable guess work, and quite a number of fires are charged to matches that occur from unknown causes; but as relating to the charges against electric lighting as having been the origin of fire in any particular case, it is very rarely indeed that it can be proved indisputably that it was due to electricity. The writer knows of several instances within the past year, where fires have been attributed to electric light wires where the origin of the fire very plainly indicated that it arose from improperly placed [illegible] wires."

About a year ago it was brought to the attention of the writer that the insurance people intended or desired to issue a ruling that on all buildings using electric lighting as a means of illumination an extra premium of 25c. on each $100 of insurance should and would be charged over and above their regular rates; that is, if the party were paying 50 cents per $100 he would be charged 75 cents if he were to use electric lighting as a means of illumination. The basis upon which the insurance people claim to have arrived at this decision was the fact that for some time past they had had a large number of heavy losses on a certain class of risks, that had theretofore not caused them losses, and that therefore they concluded that the cause and origin of fire must be from electric light wires and apparatus; and consequently they argue that all electric light privileges should be saddled with a 25-cent additional rate. It is very doubtful whether this rule will ever be enforced, as it will be almost impossible for the insurance interests in any way consistently to show that electric lighting has been the cause of any great losses, and those losses that have been sustained the insurance people are to be partially blamed for, as well as the electric lighting people. I make this assertion on the fact that the insurance people have not properly looked after their own interests, or in other words, they have not retained properly instructed and experienced inspectors at remunerative salaries and thereby insured their own insurance. The writer takes the stand that of all people, insurance companies should believe in insurance, and show their belief by employing experienced and practical men; but if they expect to hire experienced men for the munificent salary of $100 per month, to go out through the country and dictate rules and regulations to men who are capable and are in fact drawing salaries of from $200 to $500 per month, then the insurance people show their weakness, and it is owing to this weakness that they, possibly, and I might say probably, have met with a great many losses that they would not have met with if they had taken hold of the subject in a proper and consistent manner.

It is but fair to state, however, that the insurance people were led to believe from the beginning, by the people controlling the electric lighting industries in this country, that electricity was absolutely safe, no qualifying remarks being made in a great many cases by well known representatives of the leading companies, that there was a difference and distinction between good and bad work. As a great many of us know from past experiene, agents of the large companies sold a great many of their plants by stating that anyone could manage and install electric light apparatus and lights, and that there was absolutely no danger from fire; and further digressed from the truth by stating that incandescent lamps gave off *no* heat, not even qualifying this by saying, no dangerous amount of heat.

One of the troubles that did, and does still, exist between the insurance and electric lighting interests, is the lack of harmony in rulings made by the insurance inspectors. It is impossible, as we can readily understand, to formulate a set of rules that will apply in all cases, but it is possible on the part of the insurance people, and also on the part of the electric light people, to have the work looked after by experienced and intelligent men, who can come together so that the interests, instead of clashing, will harmonize; and it is as absolutely essential for the insurance interests to cultivate harmony as it is for the electric light people, and in fact, I think the writer is safe in predicting that if the insurance people would cultivate it to a greater extent with responsible electric light contracting firms and companies, it would be of great advantage to their interests in the near future, inasmuch as there is no question that electric light as a means and method of illumination, in 99 cases out of 100, is far safer, when properly installed and relied upon to the entire omission of all other methods of illumination, than any other method known at the present day.

PHOENIX.

NEW YORK, JAN. 19, 1894.

OBITUARY.

GEORGE BARTLETT PRESCOTT.

WE regret to announce the death of Mr. G. B. Prescott in this city at the age of 64. He was the son of Mark Hollis and Priscilla (Bartlett) Prescott, and was born in Kingston, N. H., September 16, 1830. He came of old fashioned New England stock on both sides. During his boyhood, the family removed from Kingston, successively locating in Plaistow, Haverhill and other places, and finally in Portland, Me., where the elder Prescott became engaged in mercantile business. It was in this city that young Prescott completed his studies. After leaving school in 1850, he engaged in the telegraphic business as an operator, and was employed in 1850 and 1851 in the Boston office of the Merchants' Line, which was then working the Bain chemical system between that city and New York. Soon afterwards he entered the service of the Commercial or "House" line in the same city, where his marked ability as an operator and electrician soon raised him to the position of superintendent of that line, and also of the local system known as the "Marine Lines" extending from Boston to Cape Cod and Cape Ann. In 1859, a general consolidation of the competing telegraph lines in New England occurred, after which Mr. Presscott was appointed to the superintendency of a district comprising most of the lines in western New England, with headquarters at Springfield. Before his removal from Boston, Mr. Prescott had contributed to the *Commercial Bulletin* of that city, a series of articles descriptive of the various systems of telegraphy then in use. These attracted considerable attention, and with other kindred matter were afterwards published in book form by Ticknor & Fields, in 1860, meeting with such success that a second and enlarged edition was called for within a few years.

In the course of the controversy respecting the proposed establishment of a government telegraph, which raged with much vehemence in 1868-69, Mr. Prescott took a prominent part in opposition to the scheme. One of his statistical articles published in a local newspaper presented his views of the matter in such a forcible way that the attention of President William Orton was attracted by it, which led to the removal of the author to New York, and to his employment in the general office of the Western Union Company, in more extended services of the same character. When the office of Electrician of the company was established, Mr. Prescott was chosen to fill the position.

Mr. Prescott was married December 9, 1857, to Eliza C., daughter of Israel W. Parsons of Springfield, Mass., a descendant of the celebrated Governor Wadsworth of Connecticut, by whose orders the Colonial charter was spirited away, just as the usurper Andros was about to seize it, and hidden in the hollow of the historic tree familiar to schoolboy students as the Charter Oak.

Mr. Prescott was the author of a number of works on telegraphy and allied subjects, among the best known of which are perhaps his "History, Theory and Practice of the Electric Telegraph," 1860; "Electricity and the Electric Telegraph," 1876; "Speaking Telephone and Talking Phonograph," 1878; and "Dynamo Electric Machines," most of which have passed through several editions. Though Mr. Prescott's works have achieved a somewhat wide popularity, their excellence has been due in a much greater measure to his skill and industry as a compiler, than to any features of marked originality either in subject or treatment which may be said to have characterized them.

DEATH OF HEINRICH HERTZ.

WE have received, as we go to press, the news of the death of Prof. Heinrich Hertz, at Bonn, at the early age of 36. This news of his death will be received with profound sorrow and regret by American physicists and electricians.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 2, 1894

Accumulators :—

Secondary Battery, W. C. Lockwood, New York, 512,253. Filed Aug. 6, 1892.

The electrodes are made by depositing metallic pins in a spongy state from a solution of chloride of sodium and chloride of tin by electrolytic action.

Alarms and Signals :—

Electric Alarm for Cane Feeders, A. F. Slangerup, New Orleans, La., 511,866. Filed Apl 28, 1893.

Electrically Controlled Railway Signal, F. McBrien, Newark, N. J., 512,050. Filed July 27, 1893.

An electrical block system for steam railways.

Electrically Controlled Railway Signal, F. McBrien, Newark, N. J., 512,051. Filed Sept. 25, 1893.

Similar to No. 512,050.

Electrically Controlled Railway Signal, J. Wayland, Newark, N. J., 512,077. Filed Oct. 5, 1893.

An electric block system for steam railways.

Electric Call, P. M. Randall, Concord, N. H., 512,217. Filed May 6, 1893.

Conductors, Conduits and Insulators :—

Electric Connection, H. Sanche, Detroit, Mich. Reissue, 11.398. Filed June 24, 1890.

Consists of a terminal piece for each wire and a turn buckle connecting the two terminal pieces.

Electrical Connection, H. Sanche, Detroit, Mich. Reissue, 11,397. Filed June 24, 1890.

Consists of a binding post having a number of terminal clamps and a jam nut holding them all together.

Section Insulator, H. M. Brockbank, Brooklyn, N. Y., 511,928. Filed Aug. 21, 1893.

Employs an insulating member separating the conducting members, and a conductor from each of the latter extending along a surface of the insulating member.

Wire Covering Machine, W. H. Avis, Toronto, Can., 512,146. Filed June 7, 1893.

Distribution :—

Storage Battery System of Distribution, J. Trumpy, Hagen, Germany, 511,821. Filed Aug. 1, 1893.

Has for its object to maintain a constant potential between the terminals so as to secure a uniform action of the translating devices in the circuits.

Storage Battery System of Distribution, J. Trumpy, Hagen, Germany, 511,822. Filed Aug. 1, 1893.

Provides automatic means for including a greater or less number of cells in the circuit as circumstances demand.

Electric Circuit Controller, R. Callender, Brantford, Can., 511,973. Filed Apl. 24, 1893.

Provides means for automatically controlling a circuit either as to the length of time it shall remain active or inactive or as to the length of time between beginning and completing the act of opening or closing the circuit.

Electrical Transmission of Power, Nikola Tesla, 511,915. Filed May 15, 1888.

A method of operating motors having independent energizing circuits consisting in passing an alternating current thorough one of the energizing circuits and inducing thereby a current in the other energizing circuit.

Regulator for Continuous Current Arc Light Circuits, D. Higham, Boston, Mass., 512,027. Filed May 14, 1892.

Employs means for producing in a branch circuit current waves differing in phase from the current waves in the main circuit and adapted to act upon the controlling device.

Transmission of Rapidly Alternating Electric Currents, W. H. Eckert, New York, 512,102. Filed Oct. 11, 1893.

The method consists in developing a series of alternating impulses and transmitting them over a conductor of bimetallic wire consisting of iron or steel combined with copper. (See THE ELECTRICAL ENGINEER, Jan. 10th).

Dynamos and Motors :—

Electric Motor, W. A. Crowdus, Chicago, Ill., 511,758. Filed Oct. 11, 1892.

A small easily constructed motor for use in connection with sewing machines, etc.

Electric Generator, N. Tesla, New York, 511,916. Filed Aug. 19, 1893.

Claim 1 follows :

The combination with the piston or equivalent element of an engine which is free to reciprocate under the action thereon of steam or a gas under pressure, of the moving conductor or element of an electric generater in direct mechanical connection therewith. (See THE ELECTRICAL ENGINEER, Jan. 10.)

Regulator for Dynamo Electric Machines, C. E. Scribner, Chicago, Ill, 512,227. Filed Dec. 29, 1887.

The method consists in changing coils of the field magnets from a shunt to a series relation with the working circuit to change the strength of the magnets.

Galvanic and Thermo-Electric Batteries :—

Cartridge Shell Battery, J. J. Pearson, Brooklyn, N. Y., 512,055. Filed Jan. 25, 1893.

A small sealed battery employing an ordinary cartridge shell for its outer casing.

Measurement :—

Ammeter and Voltmeter, J. Perry and C. E. Holland, London, Eng., 511,791. Filed April 6, 1893.

Has for its object to adapt the Ayrton & Perry magnifying spring ammeters and voltmeters to use upon a switch board in any position by giving them a vertical dial.

Electric Indicator, A. H. Hoyt, Manchester, N. H., 512,250. Filed March 15, 1893.

Has for its object to provide a device by which the movement of the needle can be checked and the reading made immediately after the current is applied.

Miscellaneous :—

Method of Removing Tin from Tin Plate Scrap, H. L. Hollis, Chicago, Ill., 511,774. Filed Jan. 13, 1892.

Consists in connecting the scrap with the positive pole of a source of electricity and removing the tin coating by electrolysis.

Electro Hydrocarbon Engine, L. C. Mann, Gladbrook, Iowa, 511,855. Filed Nov. 15, 1892.

Electric Clock, F. L. Gregory, Niagara Falls, N. Y., 511,946. Filed Apl. 19, 1892.

Electric Current Regulator, A. B. Jones, Cleveland, O., 512,115. Filed June 10, 1891.

A regulator for electrical dental tools.

Process of Purification and Decoloration of Saccharine Solutions, P. H. Vander Weyde and O. Lugo, New York, 512,133. Filed July 24, 1893.

Articles Coated With Metallic Alloys, S. O. Cowper-Coles, London, Eng., 512,160. Filed Nov. 25, 1892.

Relates to the electric deposition of certain specified alloys.

Process for Manufacturing Sugar, O. Lugo, New York, 512,200. Filed Nov. 10, 1893.

Electric Stop Motion for Warping Machines, Clayton Denn, J. Cocker and Chas. Denn, Philadelphia, Pa., 512,018. Filed Feb. 6, 1893.

Railways and Appliances :—

Trolley, W. F. Duncker, Steelton, Pa., 511,763. Filed Aug. 26, 1893.

Claim 2 follows :

A trolley having a pulley and provided at opposite sides of the same with separate outwardly tapering conical bodies provided with spiral grooves.

Trolley Mechanism for Electrically Propelled Vehicles, C. H. Veeder, Lynn, Mass., 511,824. Filed Nov. 23, 1892.

A construction of the trolley pole and connections especially adaped to electric mining locomotives.

Trolley Wire Support, C. T. Lee, Boston, Mass., 511.858. Filed Apl. 15, 1893.

Consists of an ear provided with metallic strips temporarily secured to the ear by solder and sufficiently long to be bent around the conductor while it is being permanently secured to the ear.

Electric Locomotive for Elevated Tracks, C. H. Roberts, Hartwell, O., 511,862. Filed Oct. 29. 1891.

An electric over-head railway adapted especially for logging purposes.

Trolley Catcher, G. E. Gay & J. H. Parsons, Augusta, Me., 511,941. Filed Feb. 28, 1893.

A spring attached to the trolley cord, normally held out of action but released by the tightening of the cord which occurs when the trolley leaves the wire, and actuating mechanism for winding up the cord and thus drawing down the trolley cord.

Electric Locomotive, E. M. Bentley, Boston, Mass., 511,988. Filed Oct. 24, 1891.

Relates especially to a flexible support for the motor upon the truck and means for transmitting power to the axle.

Overhead Trolley Wire Switch, G. W. Mac Kenzie, M. B. Sloan & T. C. Sloan, Beaver, Pa., 512,201. Filed Dec. 30, 1892.

Consists of a pivoted bridge piece operated by the trolley wheel of a passing car.

Switches and Cut-Outs :—

Electric Switch, J. L. Hinds, Syracuse, N. Y., 511,889. Filed May 16, 1892.

Relates to special features in the construction of jack knife switches.

Push Button, C. D. Hunking, New York, 511,953. Filed Jan. 6, 1893.

Claim :

A push button or circuit closer, comprising circuit terminals, a transparent opening, a pivoted index needle in or below the same, and an electro-magnet in the circuit of the terminals for operating the needle.

Telegraphs :—

Self Closing Telegraph Key, H. E. Moss, Kansas City, Mo., 511,787. Filed Aug. 21. 1893.

Telephones and Apparatus :—

Telephone Exchange System, R. Callender, Brantford, Can., 511,874. Filed May 12, 1893.

An automatic exchange apparatus and method of operation whereby any subscriber may obtain control of one section of the switching apparatus instantaneously, and to the exclusion of all other subscribers from the use of that particular section for a brief space of time sufficient to effect the desired connection, and then through the mechanism thus actuated to automatically disconnect the section of switching mechanism used and leave it for the use of any other subscriber, while he (the first named subscriber) continues his conversation unmolested with the subscriber called, and at the end of that conversation restores his line, and the line of the subscriber to whom he is talking, to normal condition.

Telephone Exchange System, R. Callender, Brantford, Can., 511,875. Filed Aug. 13, 1892.

Similar in its object to No 511,874.

Telephone Transmitter, S. C. Drew, Boston, Mass., 511.882. Filed Jan. 23, 1893.

Employs a diaphragm and an electrode placed in an electric circuit and a magnet arranged to be directly influenced by the vibrations of the diaphragm and by its changes in form to vary the pressure upon the electrode.

Registering Apparatus for Telephones, A. R. Duperu, San Francisco, Cal., 511,883. Filed Nov. 17, 1892.

Composite Telephonic and Multiple Telegraphic Transmission, F. A. Pickernell, Newark, N. J., 512,214. Filed Aug. 25, 1893.

The main telegraphic line serves as one side of a two wire telephone circuit.

THE NEW YORK POLICE TELEGRAPH SYSTEM.

A SUMMARY of the work performed in the New York Bureau of Police Telegraph for 1893, as given out by the Superintendent, Mr. Brennan, shows that the total number of miscellaneous messages transmitted over the police telegraph and telephone lines for police and other departments were 113,954; general alarm messages, comprising general orders of the Board of Police, Superintendent of Police, inspectors, etc., 224,364; dead animals reported over wires, 35,000.

During the year eighty miles of electric wires for the police telegraph and telephone systems were put under ground, and fifteen miles of police wires were transferred from pole lines, so as to allow the Board of Electrical Control to remove poles.

It is intended to equip all the other police stations, police courts, and public hospitals with telephones connecting directly with police headquarters, with underground wires.

HONORS FOR MR. PREECE.

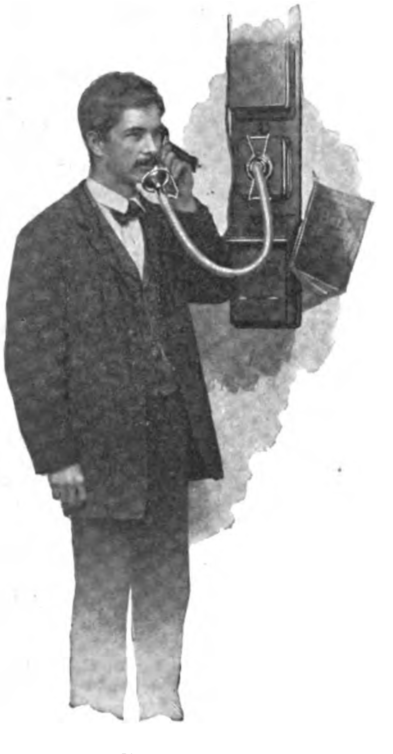
The hosts of friends of Mr. W. H. Preece, F. R. S., in this country will be delighted to learn that the Queen has included his name in the list of New Year's honors by making him a Companion of the Bath, thus recognizing his merit and honoring the profession of which Mr. Preece is so useful and distinguished a member.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE WEBER TELEPHONE ATTACHMENT.

A DEVICE for facilitating the use of wall telephones by persons of any height; obviating the necessity of stooping or standing on tip toes, as the case may be, has been introduced by Messrs. Weber & Brother, of 2,209 and 2,211 North Front street, Philadelphia, and is clearly shown in the accompanying illustration. It consists merely of a flexible tube one end of which is attached to the transmitter by a spring clip. At the other end is the ear-piece and another clip which holds the receiver at the proper distance from the mouth when in use. One may thus stand in a natural attitude, or even sit, and at the same time have an uninterrupted view of his surroundings. The attachment is said to have a very soothing influence upon the user of telephones and to enable him to roar you as softly as any sucking dove.



THE WEBER TELEPHONE ATTACHMENT.

THE QUEEN ELECTRODYNAMOMETERS.

QUEEN & Co., INC., Philadelphia, make a special form of electrodynamometer which they have supplied largely to central stations and manufacturing concerns, for use as a standard ammeter in measuring both direct and alternating currents. The fact that instruments built upon this plan are capable of very exact calibration which does not change, renders them reliable and efficient where other forms cannot be employed.

This is particularly the case in alternating work. The series of ammeters which Queen & Co. manufacture cover a range of from two tenths amp. to five hundred amperes.

INCREASED EDISON EARNINGS IN NEW YORK CITY.

THE EDISON ELECTRIC ILLUMINATING COMPANY reports for the calendar year 1893:

Gross earnings	$1,193,338	Inc.	$250,763
Operating expenses	527,311	"	141,817
Net earnings	$666,027	Inc.	$108,946
Other income	28,221	"	7,775
Total income	$694,248	Inc.	$116,722
Legal expenses and taxes	112,570	"	10,181
Net earnings	$581,678	Inc.	$106,541

ACTIVITY OF THE LA ROCHE ELECTRIC WORKS.

THE La Roche Electrical Works, Philadelphia, have installed the following plants within the last month in their own vicinity: Duncan, Hood & Co,, 400 lights; M. C. Curdy Bros., 500; R. H. Foster Works, 1,500; Hotel Emery, 200; T. Devlin & Co., 500; Allegheny Woolen Mills, 400. They have also sold plants for 1000 lights to the Westboro, Mass., Electric Light & Power Co.; Biloxi. Miss., Light and Power Co., 1000; Quincy, Mass. Electric Light and Power Co., 1300; Buckingham, N. C., 500. This is a fine list for dull times. The La Roche Works have also sold motors aggregating 150 h. p., with machinery, etc., of proportionate amount. The company are working night and day as they have now on hand to fill at once orders for nearly 8,000 lights of dynamo capacity and 75 h. p. of motors. Among the newer work just contracted for may be mentioned the Wernersville Insane Asylum plant of 2,000 lights.

The company held its annual meeting last week, when the statements presented gave evidence that for the La Roche Works at least the year had been a very successful one and that the outlook for 1894 was very bright. The company have just taken 15 additional men on, in order to keep from falling behind with the work now in hand.

ACTIVITY OF THE ELECTRIC APPLIANCE CO.

THE success of the new "Mogul" lamp is said to be nothing short of phenomenal. The orders that the factory are receiving are already taxing their capacity. It begins to look as though the "Mogul" was the coming lamp for large interior lighting, such as halls, theatres, churches, etc. In fact a number of contracts for this kind of work have already been made. The Electric Appliance Company, of Chicago, as western agents for the New York & Ohio Co., are carrying a stock of the lamps in Chicago and making large sales.

The Electric Appliance Company report that the interest manifested in the new Washington arc lamp for alternating and direct current constant potential circuits is becoming very general and inquiries and orders are coming in from all parts of the country.

METROPOLITAN ELECTRIC CO.

The following notice to the trade has just been issued by the Metropolitan Electric Co. of 186–188 Fifth Avenue, Chicago :—

> We have been transacting our business heretofore under disadvantages (on account of the necessary separation of our sales and warerooms from our offices) owing to leases existing when this company bought out the Enterprise Electric Company, which are satisfied.
>
> We have now leased a new store and warerooms that will accommodate these interests and give us more direct supervision over our affairs, with the additional advantage of increased space which will permit us to carry larger stocks of staple articles; and exhibit our specialties, insuring our customers more prompt attention than we have been able thus far to give.
>
> Please make a note of our new address, which will be permanent, 186–188 Fifth avenue, Chicago.
>
> We shall be glad to have you call upon us in an official capacity, or otherwise.
>
> Yours very truly,
> Metropolitan Electric Company,
> Wm. H. McKinlock,
> President.

THE HOWARD INCANDESCENT ARC LAMP IN HARTFORD.

WE have received a batch of testimonials from the Connecticut Royal Arc Co., as to the operation of the Howard incandescent arc lamps placed by them in the city of Hartford, in stores and offices. All the users speak of them in the highest terms, as might have been expected, dwelling in several cases also on the freedom from danger of fire.

THE BROWN PUG DOG.

ONE of the most original designs in calendars is that issued for 1894 by the Brown Electric Co., Summer and Federal streets, Boston, Mass. It represents a pug dog, who will at command sit up on a desk and present to the person interested the business card of the Brown Company, which is held in the teeth of the dog. The calendar for the year is in plain sight and the whole get up of the device is certainly novel.

MR. JOSÉ ELIGIO MOSQUERA, of Havana, Cuba, informs us that he has removed his offices and stores to No. 88 Calle del Obispo that city, where he will continue to keep on hand a large variety of electrical house, telephone, telegraph and similar supplies. He will also devote special attention to electric light and railway apparatus, and all details relating to electrical installations generally. Mr. Mosquera invites correspondence on all matters pertaining to the above.

THE WALKER MFG. CO.'S ELECTRICAL DEPARTMENT.

Since the announcement that the Walker Manufacturing Company had decided to add an electrical department to its immense plant, for the manufacture of street railroad dynamos, motors and other electrical transmission machinery, work has progressed rapidly. The first machines to be placed on the market are now nearing completion, and within a short time the company will be in active business in this line of work.

It was predicted at the time of the announcement that the Walker people would prove an unusually strong factor in the electrical field, and this prophecy is borne out by the fact that business has already been offered the company, both from Eastern and Western roads. Judging from recent reports, there appears to be no doubt in the minds of those in any way interested, of the immediate and unqualified success of the new machines. The closest attention has been paid to mechanical detail. The improvements suggested and already carried out, are considered by experts to be a distinct advance.

The "Wheel-type" idea has been followed in the designs for generators, and this plan will prevail throughout. So far it has been impossible to obtain details of construction, as the company's officers are not yet ready to give out specific information.

WALLACE ELECTRIC COMPANY.

The Wallace Electric Co. of 104 Michigan avenue, Chicago, has issued the following important announcement:—

> We take pleasure in informing our friends and the trade that the Wallace Electric Company has been organized for the purpose of conducting a business in electrical goods as manufacturers and manufacturers' agents.
>
> Our line embraces alternating current generators, motors, meters, transformers, etc.
>
> Wires and cables for all electrical purposes.
>
> Incandescent and arc lamps, measuring and indicating instruments, switches, etc.
>
> Also a full line of electrical street railway appliances and supplies and a few carefully selected specialties.
>
> The officers and management of the Company are well known to the trade. Our General Manager, Mr. J. B. Wallace, has been actively identified with electrical industries from the earliest experimental stages of electric lighting in this country. Mr. Wm. S. Hine, our President, has had a large experience in this business through his connection with the U. S. Electric Lighting Co. and the Westinghouse Electric and Mfg. Co. as General District Agent. Mr. Max A. Berg, Secretary of the Company, is well known as the former Manager of the Street Railway Dept. of the Ansonia Electric Co., and Mr. M. M. Wood, whose special devices are rapidly becoming the standard for Street Railway Construction, will be our Electrical Engineer in this department.
>
> We are not Electrical Supply Dealers, but as Manufacturers and Manufacturers' Agents, are in a position to sell directly to large consumers and the trade at manufacturers' prices and without an intervening profit.
>
> Catalogues, price lists, etc., are in press and will be mailed on application.
>
> We are thoroughly equipped to promptly and satisfactorily handle your business and solicit your orders.

THE COLUMBIA INCANDESCENT LAMP.

President J. H. Rhotehamel, of the Columbia Incandescent Lamp Co., St. Louis, reports that the recent reduction in price of their lamps has overflowed their factory with orders. They have been compelled to operate overtime and are now considerably behind. He says: "There is no question that the users of incandescent lamps in the United States are beginning to appreciate the fight we have made for an open market; and the most substantial evidence we have of this is our orders from all sections o country."

BERLIN IRON BRIDGE CO.

The new works of the Stanley Electric Mfg. Co., at Pittsfield, Mass., will be entirely of iron, designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn.

The Berlin Iron Bridge Co., are putting the roof on a building for the United Sates Government, at Fort Wadsworth, N. Y. The building is 41 feet wide and 231 feet long, the roof being made entirely of iron,—iron trusses covered with corrugated iron.

HOW THE STUDENTS LIKE IT.

A student at one of the leading technological institutes writes: "I take pleasure in enclosing my subscription for the coming year to The Electrical Engineer. as I have found it the finest in the land."

NEW ENGLAND NOTES.

Our New England Office extends its thanks for beautiful calendars to the W. S. Hill Electric Company, the Hawks Electric Company, the Pettingell Andrews Company, the Brown Electric Company, A. & J. M. Anderson, and many others who were kind enough to send them. Yet there is room.

The Page Belting Co. of Concord, N. H., have made a decided hit by publishing in diploma form their award at the World's Fair, accompanied by a facsimile of the St. Gaudens medal which is now creating such a sensation in sewing circles and the U. S. Senate because of the nudity of a male figure on one side of it.

Messrs. A. and J. M. Anderson, of Boston, in sending out their New Year's cards, which consists of a four-page circular showing cuts of their various railway appliances, together with a circular letter or two and a memorandum of an official test of their "Brooklyn Strain Insulator," have inclosed a very handsome calendar for 1894. The engraving is a work of art, making a picture pleasing to the eye, while the calendar proper is most satisfactory and useful.

NEW YORK NOTES.

Mr. A. B. Lawrence, 225 Pearl street, sends us a very showy and pretty calendar of the celebrated Shultz belting. Engineers and superintendents can get copies of it for the asking and a 2-cent postage stamp.

Messrs. Bogle & Scott, importers and grocers, of 87 and 89 Park Place, have installed in their new building at 120 Hudson street, New York, a 60-light Belknap dynamo which will be run by a well-known make of gas engine.

Mr. Wm. H. McKinlock, president of the Metropolitan Electric Company, Chicago, has been called to New York to close a contract for a full line of specialities, which the company are now in a position to handle advantageously in their commodious store and warerooms, 186 and 188 Fifth ave.

The Cowles Electric Smelting & Aluminum Co. of Lockport, N. Y. authorize and request us to contradict the report that they are consolidating with the Pittsburgh Reduction Co. or have any intention of so doing. They do not expect to remove to Niagara Falls and their Lockport works are in active operation as usual turning out aluminum and its alloys.

The Reward for Inventors.—Mr. Edward P. Thompson, 3 to 7 Beekman St., New York, reports patent searches in electric railway systems, which would naturally suggest that inventors are competing for the $50,000 prize decreed by the Metropolitan Traction Co. He has done so much in this direction just lately that he feels competent to furnish inventors with the whole history of electric railways of all types.

The Abendroth & Root Mfg. Co., 28 Cliff street, are quite pleased at having secured the contract for 4,000 h. p. of boilers from the Cincinnati Street Railway Co. This will be the complete boiler equipment in two power houses, and part of the equipment in a third. The company also report having secured the services of Mr. P. McLaren, one of the oldest and most successful representative salesmen in the boiler trade. Their outlook was never better than to day.

The Consolidated Car Heating Co. of Albany has begun suit in the United States Circuit Court against the Chicago & West Michigan Railway for infringement of the Sewall coupler patents. The alleged infringement consists of using an imitation of the Sewall Steam Coupler recently put upon the market. This railway is the first to continue the use of the imitation coupler after notification, and the Consolidated Car-Heating Co. at once determined to take action to protect the patents issued to Messrs. D. D. and J. H. Sewall.

PHILADELPHIA NOTES.

The Altoona Manufacturing Company, of Altoona, Pa., builders of the M. A. Green engines, have recently appointed T. T. Burchfield, No. 55 North 7th St., Philadelphia, Pa., as their representative in that city.

Spaulding & Metcalf have removed to their now store 532 Arch street, where they will carry a more complete line of mill and electrical supplies. Their business is growing rapidly and 1894 promises to be a very prosperous year for them.

Mr. Chas. Blizard, general sales agent, Electric Storage Battery Co., of Philadelphia, is at present in Chicago, and will probably remain there for some weeks looking up prospective business. He will possibly arrange for permanent operations in the West. Pending these arrangements he has taken temporary offices in Chicago, 302 Owings Building.

The Main Belting Co., of Philadelphia, have issued a gilt-edged pocket memorandum book, with celluloid covers, bound with leather. The name and address of the Company, and a "Group of Leviathans" are in possession of the front cover, while the back is occupied by a calendar for the year. There are contained in the book a price list of belts, some general instructions as to their handling, and a few remarks calculated to instruct the user as to how to get the most work from his belting.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVII. JANUARY 31, 1894. No. 300.

BI-METALLIC TELEPHONIC CONDUCTORS AND THEIR RELATION TO RESONANCE ON LONG DISTANCE CIRCUITS.

BY F. W. DUNBAR.

IN an interesting article appearing in THE ELECTRICAL ENGINEER of Jan. 10,[1] the possible advantages of a composite or bimetallic conductor for telephonic purposes are brought forward. It has been the universal experience that a plain iron or steel conductor is unsuited for telephonic transmission over long distances. Not only is the volume of the transmitted sound less over such circuits than over the standard copper circuits, even if the weight per mile be increased sufficiently to secure an equal conductivity, but also the quality of the transmission is inferior. Were it not for this second reason it would at first thought appear possible to advantageously use simple iron or steel circuits in place of copper for distances exceeding several hundred miles. For, as is commonly recognized, on copper circuits of such a length the value of the current at the receiving end may be increased by the addition of the proper amount of distributed self-induction, or retardation If then an iron wire were substituted of equal conductivity to the copper, and consequently weighing about six times as much, it would seem possible to increase the value of the current at the receiving end, if the increased self induction of the iron were of the proper amount.

The value of the self-induction necessary to secure a maximum current at the distant end is given by $L = \frac{C R^2 l^2}{16}$ in henrys per mile, where

C = capacity in farads to ground per mile,
R = resistance in ohms per mile,
l = length of metallic circuit in miles.

This is an approximate equation true when the rate of alternation is within the range of the telephonic vibrations and upon lines exceeding several hundred miles in length; that is upon those lines where resonance is possible. This yields for a metallic circuit of 2,000 miles (or a distance of 1,000 miles, corresponding closely to the Chicago line) with No. 8 B. W. G. copper wires 30 feet above the ground $\frac{.017 \times 4.84 \times 4 \times 10^6}{10^6 \times 16} = .0204$ henry per mile. In practice these wires have but about .00165 henry per mile, or less than a tenth of the value necessary to secure the maximum possible current.

The value of the inductance of a No. 000 B. W. G. iron wire in place of the No. 8 copper would be, assuming a value of 150 for the inductivity of the iron, $75 + 2 \log_e \frac{d}{r} = 83$ cm. per cm. or .0123 henry per mile. This is the value of μ given by Mr. Kennelly and substantiated by the experiments of Lord Rayleigh. Thus the circuit if built of No. 000 iron would come much nearer to yielding the amount of inductance necessary to secure a maximum current at the distant end. As a matter of fact any nearer approach would be attended with but a very slight increase in the current.

The increased size of the iron wire would have increased the capacity over the copper wire in the ratio of

$$\frac{\log \frac{4h}{d}}{\log \frac{4h}{d} - \log \frac{.425}{.165}} = 1.117;$$

where h is the height of the wire in cms. above ground and d is the diameter of the copper wire in cms. The No. 8 copper wire has a capacity of .017 microfarad per mile, hence the No. 000 iron will have a capacity of .019 microfarad per mile.

The value of the current at 160 cycles per second at the distant end of the circuit when the sine of the phase is unity is for No. 8 copper wire

$$\frac{2E\sqrt{\frac{17}{10^6}}\; e^{\sqrt{\frac{17}{2}}\sqrt{(4.84+2.56)^{\frac{1}{2}}-1.6}}}{\sqrt[4]{4.84+2.56}\; e^{2\sqrt{\frac{17}{2}}\sqrt{(4.84+2.56)^{\frac{1}{2}}-1.6}}-1} = E \times .000244$$

ampere, and for the iron wire

$$\frac{2E\sqrt{\frac{19}{10^6}}\; e^{\sqrt{\frac{19}{2}}\sqrt{(4.+151.29)^{\frac{1}{2}}-12.8}}}{\sqrt[4]{4+151.29}\; e^{2\sqrt{\frac{19}{2}}\sqrt{(4.+151.29)^{\frac{1}{2}}-12.8}}-1} = E \times .000798$$

ampere.

Thus, were simple iron wires weighing six times as much as the copper, used in place of the copper, the resulting current would apparently be increased over 200 per cent.; a result that is not in accordance with all inferences to be drawn from actual observations.

But as Maxwell and many subsequent writers have shown, the true resistance which a conductor offers to an alternating current is greater than that resistance which it offers to a uniform current. This statement is entirely distinct from the increase in apparent resistance, due to the self induction of the circuit itself, and commonly termed the impedance, $\sqrt{R^2 + L^2 \omega^2}$. The increase spoken of is an actual increase in the resistance of the conductor itself and causes a greater energy dissipation in the form of heat.

It is caused by the unequal densities which the current assumes throughout the cross-section of the conductor and increases in amount as the density becomes less and less uniform. As an alternating current can only establish itself by continually overcoming and reversing its own field of self induction, and as its own self induction is a function of the distribution of the current throughout the cross-section of the conductor, it will naturally assume that distribution which yields the lowest self-induction, or which offers the minimum opposition to its change. The equation of the self-induction per unit of length is for a uniform distribution $L = \frac{\mu}{2} + 2 \log_e \frac{d}{r}$, where μ represents the inductivity of the conductor and air is assumed as the dielectric. The first term follows naturally from the consideration that the lines of force contained by the conductor itself cut on the average but one half the total current when the distribution is uniform, as assumed. If however we assume the distribution to be an entirely surface distribution then the first term of the self-induction $\left(\frac{\mu}{2}\right)$ entirely disappears.

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[1] Bi-Metallic Wires for Telephone Conductors.

Thus, an alternating current will seek a distribution which decreases in density toward the core of the conductor and hence the true resistance of that conductor will be increased and its true self induction decreased.

The magnitude of these changes depends upon the possible decrement of self induction secured by means of this change in the distribution and hence varies with the permeability of the conductor. As μ is approximately unity for copper, $\frac{\mu}{2}$ will form but a small portion of the total self-induction of a copper circuit and consequently the increase in resistance and decrease in self induction will be negligible until excessive rates of alternations and diameters of conductor are reached.

But as the term $\frac{\mu}{2}$ forms the principle part of the self-induction of iron wire circuits the true resistance and self-induction will be considerably altered for telephonic rates.

The true resistance per unit length (cm.) is given by the series developed by Lord Rayleigh.

$$R_1 = R\left[1 + \frac{1}{12}\left(\frac{\omega^2\ \mu^2}{R^2}\right) - \frac{1}{180}\left(\frac{\omega^4\ \mu^4}{R^4}\right) + \ .\ .\ \right]$$

For an iron wire as large as No. 000 B. W. G. the term $\left(\frac{\omega\,\mu}{R}\right)$, at even 160 alternations per second, too greatly exceeds unity to be readily developed. We can however approximate its value from the values of those sizes which the series will readily develop.

Ohms per mile.	Percentage increase in resistance @ 160 ~	
	Calculated.	Exterpolated.
64.	1.18	
32.	4.58	
16.	16.23	
8.	approx. 45.	
4.		90
No. 000 2.		160

Thus the iron wire assumed to have a resistance of two ohms per mile has really about 5.2 ohms per mile at 160 alterations per second. Also, as seen, the true resistance is different for every rate of alternation, increasing at low rates with the square of the rate and at all time increasing rapidly with the rate. At 320 alternations the true resistance would be approximately 7.5 ohms.

Thus the apparent increase in current at the distant end by the substitution of iron wires in place of copper disappears, for the true resistance is greater and the true self-induction less, than those values used in the calculation, and both of these factors tend to rapidly decrease the value of the receiving current.

But the mere fact of the increase in resistance with an increase in the rate of alternation would be sufficient in itself to debar the use of simple iron circuits for telephonic transmission; for as the higher overtones will be present with diminishing intensity the articulation must necessarily be poor and will grow worse as the line is increased in length. But the bi-metallic conductor which Mr. Eckert proposes has a heavy copper deposit upon an iron core. Therefore its true resistance would be but little altered by an increase in the rate of alternation, and we should expect it to give practically as good articulation as a pure copper conductor. Also as the copper sheath forms the principal conductor for the telephonic current we should expect a volume of transmission equal to that secured by a pure copper conductor of the same conductivity, or to that secured if he should neglect to put in the iron core.

Mr. Eckert's point that a single bi-metallic conductor has an efficiency in volume and articulation equal to that secured by two all-copper metallic conductors of equal conductivity per unit length and used as a closed metallic circuit, is undoubtedly true. It is equally true with reference to a single all-copper conductor.

The addition of the "return" wire in the metallic circuit was not made either to increase the volume nor improve the quality of the transmission; both remain practically unchanged; but the earth currents which are always present to a greater or less extent, and which increase in intensity with an increase in distance, together with the inability to prevent cross-talk between parallel grounded circuits were the causes which necessitated the addition of the "return" wire.

Had Mr. Eckert reversed the position of his metals and used a conductor with a copper core and an iron sheath he would have placed his iron where it would be useful; for then he would have secured a copper conductor possessing all the advantages of an increased retardation and none of the disadvantages of a pure iron conductor, *if the ratio between the iron and copper is of the proper value.*

The equation for the self-induction of such a circuit is

$$L = \tfrac{1}{2} + 2\log_e\frac{d}{r} + 2\,\mu\log_e\frac{r_1}{r}$$

where r_1 and r are the radii of the sheath and core respectively and d is the distance between the conductors. $\mu = 150$ as before.

The problem is to put on an iron sheath just sufficient to make $L = 20.4$ henrys per mile. $2\log_e\frac{d}{r} = 10.00$; hence $\log_e\frac{r_1}{r} = \frac{117}{300} = .39$ or $\frac{r_1}{r} = 1.48$, hence $r_1 = .244$.

Therefore, if an iron sheath .079 thick were added to the copper conductors under discussion the inductance would be just sufficiently increased to bring the circuit into resonance and yield the maximum possible current at the distant end.

The ratio between the currents at the transmitting and receiving end of the line is $\frac{2\,e^{\frac{pl}{2}}}{e^{pl}+1}$.

When the capacity and self-induction are present in the proper proportions to bring the line in resonance the exponent $\frac{pl}{2}$ has a value unity, and the ratio becomes $\frac{2\,e}{e^2+1} = .64$.

Hence, when a circuit containing distributed capacity and self-induction is brought into resonance and the current at the distant end thus rendered a maximum, there is still a considerable loss upon the line.

This is, of course, due to the short-circuiting effect of the capacity of the line and was admirably pointed out by Dr. Pupin in his lecture before the New York Electrical Society January 16, 1893.

This loss may be still farther reduced by increasing again the self-induction of the line and when the self-induction has an infinite value the loss will be zero—so also will the current be at all points of the circuit.

This is the mistake that many writers too well known to require mentioning have made. They have aimed at securing a minimum loss upon the line, which is entirely different from bringing the line into resonance and thus rendering a maximum current at the distant end.

The interesting point is that the percentage loss upon the line (36 per cent.) is independent of the length of the circuit. This however does not mean that the *current* at the distant end is independent of the length of circuit.

The bringing of a line into resonance increases its "resiliency"—stiffens it up, as it were. It can no longer receive the same amount of current at the transmitting end for a given impressed E. M. F. but the decreased amount which it does receive, it transmits with perfect resonance and with a uniform loss of 36 per cent.

The point has already been made in my article appearing in THE ELECTRICAL ENGINEER of January 10, 1894, page 29, equation (11), that if a circuit containing distributed capacity and self induction be brought into resonance for any wave length within the range of telephonic vibrations, it will be perfectly resonant to any other. This is distinctly different from the laws of localized capacity and self induction and is the salvation of long distance telephony. For if pains be taken to bring the circuit into resonance, no matter what its length may be, the articulation will suffer no loss during transmission.

One other point in the resonance of circuits is important and instructive. The value of the current at the distant end of the circuit secured when the line is in resonance is always greater than that current which could be secured by an equal impressed E. M. F. were the line devoid of capacity and self-induction, and thus followed Ohm's law with *no* loss upon the line.

In conclusion then we would seem justified, in saying that were an iron sleeve .08 inch thick (or even .04 inch would yield practically identical results) added to the No. 8 B. W. G. copper wire between New York and Chicago, the circuit would be brought into resonance and the current at the receiving end would be but 36 per cent. weaker than at the transmitting end. This would bring Chicago practically 700 miles nearer New York, and would allow commercial conversation to be carried on by means of anything from the original Reis transmitter to the latest form of long distance instruments.

A more practical consideration however is, that had about one-third the amount of copper been put in the circuits between New York and Chicago, the value of a second third been placed in an iron sheath and the remaining third been allowed to repose in the pockets of the investing public, our business men of to-day who now have to surrender nine whole dollars for every five minutes conversation, would be getting more for their money and a more satisfactory article at that.

INFLUENCE OF COLD ON MAGNETS AND ELECTRIC DISCHARGE IN VACUO.

Prof. Dewar is making steady progress in his wonderful discoveries as to the effects of low temperature. He gave the results of his more recent experiments in a lecture before the Royal Institution, London. The table was covered with many flasks of liquefied air enveloped in carbonic acid snow. He said he had proved that at absolute zero all metals have the same degree of conductivity to electricity, however much they may differ at higher temperatures. Prof. Gladstone's theory of refractive indices of gases had been perfectly confirmed. He found that a low temperature greatly increased the strength of metals. Iron at — 180° centigrade had twice the cohesive power it possesses at an ordinary temperature.

A fully saturated magnet was found to have its power greatly increased by a reduction to — 180° centigrade. Intense cold has a strange effect on color. Professor Dewar sponged a scarlet card painted with iodine with liquefied air, and the brilliant scarlet changed to orange, but recovered its original hue immediately after it became warm again. Many brilliant experiments were made by sending electric discharges through exhausted glass globes. All the well-known phenomena of phosphorescence ceased as soon as intense cold was applied. The electricity tried to pass by any route rather than through the globe. What did this mean? asked Professor Dewar. Obviously that something was now frozen out which had before enabled electricity to pass across the vacuous space.

THE COPPER-ZINC ACCUMULATOR.—II.

BY

D Paul Schoop

The explanation of what constitutes the chemical part of the Lalande cell, given in Part I, will be often referred to later on, since about the same reactions occur during the discharge of the Desmazures and of the Phillips-Entz secondary battery. Let us confess at once, that most likely the chemical or electro-chemical processes during the discharge of Lalande's battery are far from being as here set forth. The *tendencies* of each reaction, pointed out separately above, may be working all at the same time, each tendency contributing a certain percentage to the total amount of molecular strain which brings forth the final result.

Lalande has no doubt given a good deal of consideration to the question of electrically regenerating his discharged battery, but has never claimed to have performed it. He proposed, to "revive" or regenerate one part of the battery, the porous, metallic copper, by exposing it to the air, whereby oxygen is absorbed by the copper. It depends upon how finely divided or porous the spongy copper is, at what temperature it is exposed to the air, and whether the caustic potash remaining in the spongy mass has been more or less carefully washed out—whether more or less oxygen is taken up by the copper; or in other words, how far the regeneration is carried on. By washing the spongy copper of the discharged Lalande cell with distilled water, drying the wet material to drive out all the water, and finally heating it to about 300 degrees C., the regeneration is perfected and by placing this product again in the battery, the same amount of current may be again delivered from it, provided there is still zinc and caustic-potash in abundance.

Instead of regenerating the oxidized copper in this way, it can be done electrically. But it seems doubtful at first sight, whether this will be as cheap a way as the one just described. Besides, the electric method is not at all so simple. If a current is passed through the discharged Lalande cell in opposite direction to the discharge current, it will be found that the porous copper takes up oxygen and is changed into suboxide of copper, of a reddish or yellowish color, according to the nature of the reaction. But as soon as there is a trace of the higher oxidized black oxide of copper formed, the liquid near the copper side will acquire a pure blue color and, on closer investigation, will be found to contain copper.

The electrolytic liquid therefore *dissolves* part of the substance, formed by regenerating the copper anode. On the zinc plate, a very spongy, grey deposit will be seen, mainly at the line where the zinc plate cuts the surface of the liquid, or, if the plate be entirely submerged in the electrolyte, at its edges. This spongy substance is by no means pure zinc, but it contains a suboxide of zinc, mixed with more or less metallic zinc or, perhaps, also a compound of zinc and hydrogen. Therefore the regeneration of the zinc is not carried on by the electric current, in a regular and smooth way; it depends on the density of the current, the temperature of the cell, the composition of the electrolyte, and on a good many other points besides, how the deposit at the zinc plate is formed. Further on these points will be examined more closely; it may be mentioned here briefly, that as soon as a trace of the blue copper containing liquid reaches the zinc plate, a black deposit of finely divided copper is immediately observed on the zinc. At this stage local action is set up between the trace of copper and the zinc plate, causing the zinc to oxidize and dissolve in the alkaline liquid, while gaseous hydrogen escapes freely from the deposited copper.[1]

The Desmazures Battery. With a view to facilitating the electrical regeneration of the Lalande battery, Mr. Desmazures has given it an entirely different construction and has been forced to alter every single part of it correspondingly. The anode or the copper part is made by compressing finely divided copper—as obtained for instance by mixing precipitated oxide of copper with zinc powder and pouring this mixture into a solution of caustic soda, or as obtained by certain galvanic reactions—on a network of copper-wire. The pressure is about 1,000 atmospheres.

In this way, a plate of porous copper is obtained, about 3 mm. thick, and of sufficient mechanical strength to stand all the handling and shocks of practical use. The specific gravity of this copper plate, although it is pretty firm and hard, does not exceed 4.1 (about one-half of the specific gravity of the solid copper) and absorbs with great facility the bodies deposited by the galvanic reactions on its surface. The plate is surrounded by a frame and provided with a proper connection and then put in an envelope of parchment paper. A grid of insulating material, such as whiting or similar substance, insoluble in the alkaline liquid, is put on both sides of the plate and again an envelope of parchment paper is applied around the whole structure. In this way, the total thickness of the anode is about 7 millimetres.

The cathode, or that electrode at which the zinc is deposited, consists of three pieces of steel wire network, held together by an outer frame of sheet steel and a connection piece on top of the plate, which is rivetted to the steel network. Plugs of insulating material are attached to the plate, in order to keep it at uniform distance from the anode. Instead of insulating plugs, a grid of ebonite may be laid on each side of the cathode, so that the thickness of this part amounts to about 8 or 9 millimetres.

The box is made of sheet steel of 1 mm. thickness. The copper plate and the steel wire plates are placed alternately in the box, and the plates pressed tightly together. The connections are made by screwing all the copper connectors together and the same is done with all the steel connectors. The box is provided with an air-tight cover of sheet steel, through which the two poles of the cell enter. A little valve for the outlet of gases is also fixed on the cover.

The electrolyte consists of a concentrated solution of caustic-potash with a certain percentage of zinc dissolved in it and containing also some mercury. Its specific gravity is about 1.6; the liquid is colorless and without any odor. It is covered with paraffine oil, to prevent the absorption of carbonic acid from the air. The addition of mercury to the liquid greatly facilitates the proper deposition of zinc and suppresses also part of the local action between the deposited zinc and the liquid.

It is claimed by the inventor of this battery that its efficiency is even superior to that of any type of the lead accumulator. No current is lost during the charging of the battery, since no gas is developed even by overcharging. The internal resistance of the cell is given as 0.35 ohm per square-decimetre surface of plates (average). The efficiency in watt hours is given as 80 per cent. under normal conditions. The reliability, durability and convenience in handling this battery are stated to be superior to that of a lead cell, while the output of electric energy per unit of weight is claimed to be at least 1½ times as great as that of the best and lightest lead cell.

It is important to keep this copper-zinc accumulator free from contamination with ammonia, nitric acid, chlorine, or any like substances, liable to attack the copper or steel in the cell.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—IV.

BY

Mary A. Henry

Still brooding over the theory of Ampere, Henry was not content. The current was still led, although in a less degree, in an oblique direction, and not at right angles to the length of the iron bar. Sitting one evening at home in his study, lost in a deep revery, although a friend was with him, the idea came to him that he could obtain the condition the theory required by winding the wire backward and forward in several layers around the iron core.

> **"The successive spirals of wire, coiling first in one direction then in the other, would tend to produce a resultant action of the current at right angles to the core, and that furthermore in the great number of revolutions thus obtained the current would act on a greater number of molecules of the bar and so excite greater magnetism."**

He sprang to his feet, and striking his hand upon the table near him exclaimed: "To-morrow I will make an experiment which in its result will astonish the world." "When the conception," he said, "came into my brain, I was so pleased with it I could not help rising to my feet and giving it my hearty approbation!" (If this seems at variance with Henry's well-known and great modesty it must be remembered that it was an involuntary expression of delight, uttered only in the presence of a very intimate friend. Even modesty could not blind his eyes to the value of his researches in their bearing on the telegraph, which at this time, as later, he fully recognized). He made the experiment the next day, and to his delight and encouragement success again rewarded him.

He tested his theory on the magnet we have just described as lifting fourteen pounds. Over the wire, which was already closely wound on the iron core, he wound another insulated wire, in such a way as to give the effect of a long continuous wire wound upon itself. He says:

> **"A second wire of the same length as the first was wound over it, and the ends soldered to the zinc and copper in such a manner that the galvanic current might circulate in the same direction, or, in other words, that the two wires might act as one; the effect by this addition was doubled, as the horse-shoe, with the same plates before used, now supported 28 lbs. With a pair of plates, 4 inches by 6 inches, it lifted 89 lbs., or more than *fifty times its own weight*."**

Where was Sturgeon's magnet now, lifting only its nine pounds with its battery of one hundred and thirty plates, in comparison with this magnet of Henry's sustaining fifty times its own weight under the influence of only a single pair of plates? Fig. 1.

"The same principle," Henry says "was extended by employing a still longer insulated wire, and winding several strata of this over the first, care being taken to insure the insulation between each stratum, by a covering of silk ribbon. By this arrangement the rod was surrounded by a compound helix, formed of a long wire of many coils, instead of a single helix of a few coils."

> **"In the arrangements of Arago and Sturgeon the several turns of wire were not precisely at right angles to the axis of the rod as they should be to produce the effect required by the theory, but slightly oblique, and therefore each tended to develop a separate magnetism not coincident with the axis of the bar. But in winding the wire upon and over itself the obliquity of the several turns**

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[1] **Professor H. S. Carhart, in his book, "Primary Batteries," gives a splendid description with illustrations of three different types of the Lalande battery, and most careful and scientific tests of the Edison-Lalande type. The perusal of Professor Carhart's book is highly recommended to all interested in this subject.**

compensated each other, and the resultant action was at right angles to the bar. The arrangement then introduced by myself was superior to those of Arago and Sturgeon, first, in the greater multiplicity of turns of wire, and, second, in the better application of these turns to the development of magnetism. The power of the instrument with the same amount of galvanic force was by this arrangement several times increased."

Was there a limit to the process; could the magnet already so strong continue to increase in power as more and more wire was wound in this way upon it? Henry found, after a certain length of wire had been coiled upon the iron, that the power diminished with the further increase of the number of turns. This was due "to the increased resistance which the longer wire offered to the conduction of the electricity." Had a limit indeed come to the power of the hitherto willing magnet to respond to the ever increasing demands of the young philosopher? No; Henry, undaunted, conceived a method of producing still greater power. He says:

> "Two methods of improvement suggested themselves. The first consisted, not in increasing the length of the coil, but in using a number of separate coils on the same piece of iron. By this arrangement the resistance to the conduction of the electricity was diminished and a greater quantity made to circulate around the iron from the battery. The second method of producing a similar result consisted in increasing the number of elements of the battery, or in other words, the projectile force of the electricity, which enabled it to pass through an increased number of turns of wire, and thus, by increasing the length of the wire, to develop the maximum power of the iron."[2]

In order to test the first method "a number of compound helices were placed on the same bar, their ends left projecting and so numbered, that they could be all united into one helix, or variously combined into sets of lesser length." So there came into being another magnet, shown in Fig. 2. The magnetic effect was greatly increased. We quote again from Henry:

> "These experiments conclusively prove that a great development of magnetism could be effected by a very small galvanic element; and also that the power of the coil was materially increased by multiplying the number of wires, without increasing the length of each.
>
> "The multiplication of the wires increases the power in two ways; first, by conducting a greater quantity of galvanism, and secondly, by giving it a more proper direction; for since the action of a galvanic current is directly at right angles to the axis of a magnetic needle, by using several shorter wires we can wind one on each inch of the length of the bar to be magnetized, so that the magnetism of each inch will be developed by a separate wire; in this way the action of each particular coil becomes very nearly at right angles to the axis of the bar, and consequently the effect is the greatest possible. This principle is of much greater importance when large bars are used. The advantage of a greater conducting power from using several wires might, in a less degree, be obtained by substituting for them one large wire of equal sectional area, but in this case the obliquity of the spiral would be much greater and consequently the magnetic action less; besides this, the effect seems to depend in some degree on the number of turns, which is much increased by using a number of small wires. (Several small wires conduct more common electricity from the machine than one large wire of equal sectional area: the same is probably the case though in a less degree in galvanism)"

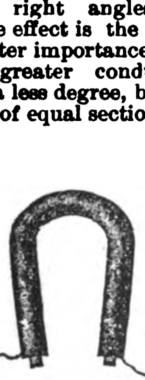

FIG. 1.—HENRY'S "INTENSITY" MAGNET.

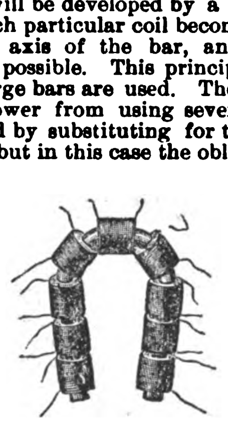

FIG. 2.—HENRY'S "QUANTITY" MAGNET.

In Henry's cabinet were now two distinctly different magnets, one with a long continuous coil of fine wire, wound back and forth on itself; the other with a number of short thick wires; the latter much the stronger. He called the one the "*Intensity*" the other the "*Quantity*" magnet. We will let him tell why he thus designated them.

> "From a series of experiments with this and other magnets it was proved, that, in order to produce the greatest amount of magnetism from a battery of a single cup, a number of helices is required; but when a compound battery is used, then one long wire must be employed, making many turns around the iron, the length of wire, and consequently the number of turns, being commensurate with the projectile power of the battery.

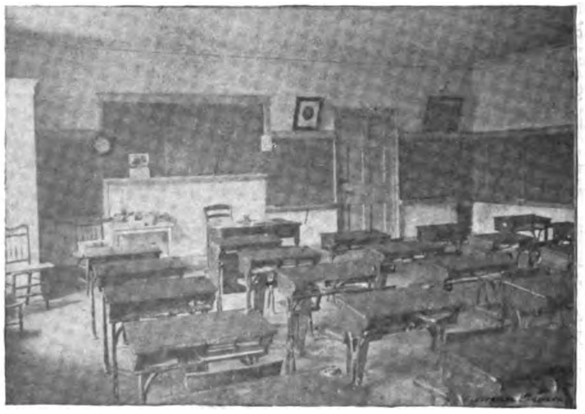

FIG. 3.—ROOM IN ALBANY ACADEMY, ORIGINALLY OCCUPIED BY HENRY.

> "In describing the results of my experiments, the terms *intensity* and *quantity* magnets were introduced, to avoid circumlocution, and were intended to be used merely in a technical sense. By the *intensity* magnet I designated a piece of soft iron, so surrounded with wire that its magnetic power could be called into operation by an *intensity* battery, and by a *quantity* magnet, a piece of iron so surrounded by a number of separate coils, that its magnetism could be fully developed by a *quantity* battery. I was the first to point out this connection of the two kinds of the battery with the two forms of the magnet in my paper in *Silliman's Journal*, January, 1831, and clearly to state that when magnetism was to be developed by means of a compound battery, one long coil was to be employed, and when the maximum effect was to be produced by a single battery a number of single strands were to be used."

The Institute was not insensible to the value of Henry's contribution to science and art, as the young man appeared again and again before the society, each time with magnets more powerful. These were received with enthusiasm and the fame passed beyond Albany to give their maker distinction.

Let us glance at the room that Henry occupied while making these experiments. An item recorded in one of the books of the Academy, Sept. 8, 1826, when Henry entered the Institution as a professor, tells us which room was assigned him, a room which he retained until the latter part of the year 1829: "*Resolved* that Prof. Henry be allowed the use of the South West Room in the third story of the Academy during the pleasure of the Board." This was Henry's work room, school room, lecture room. A long table extended across one side, and from this a series of long benches, rising in tiers one above the other filled the room. The illustration we give, Fig. 3, is from a photograph of the room as it is now, still used as a school room by the Academy.

AN ELECTRIC FREIGHT SERVICE BETWEEN ALBANY AND TROY, N. Y.

The express cars to be used by the Albany City railway company in carrying merchandise between Albany and Troy are equipped with motors and are ready to be placed in use on the road. The company have secured the building at the corner of Broadway and Nineteenth street, West Troy, for a depot, and as soon as an office shall be fitted in the building at the corner of State and Dean streets, Albany, the express line will be put in operation. It is expected the placing of the cars on the road will lead to a lively rate war with the owners of express wagons between Albany and Troy. The cars will commence running about April 1.

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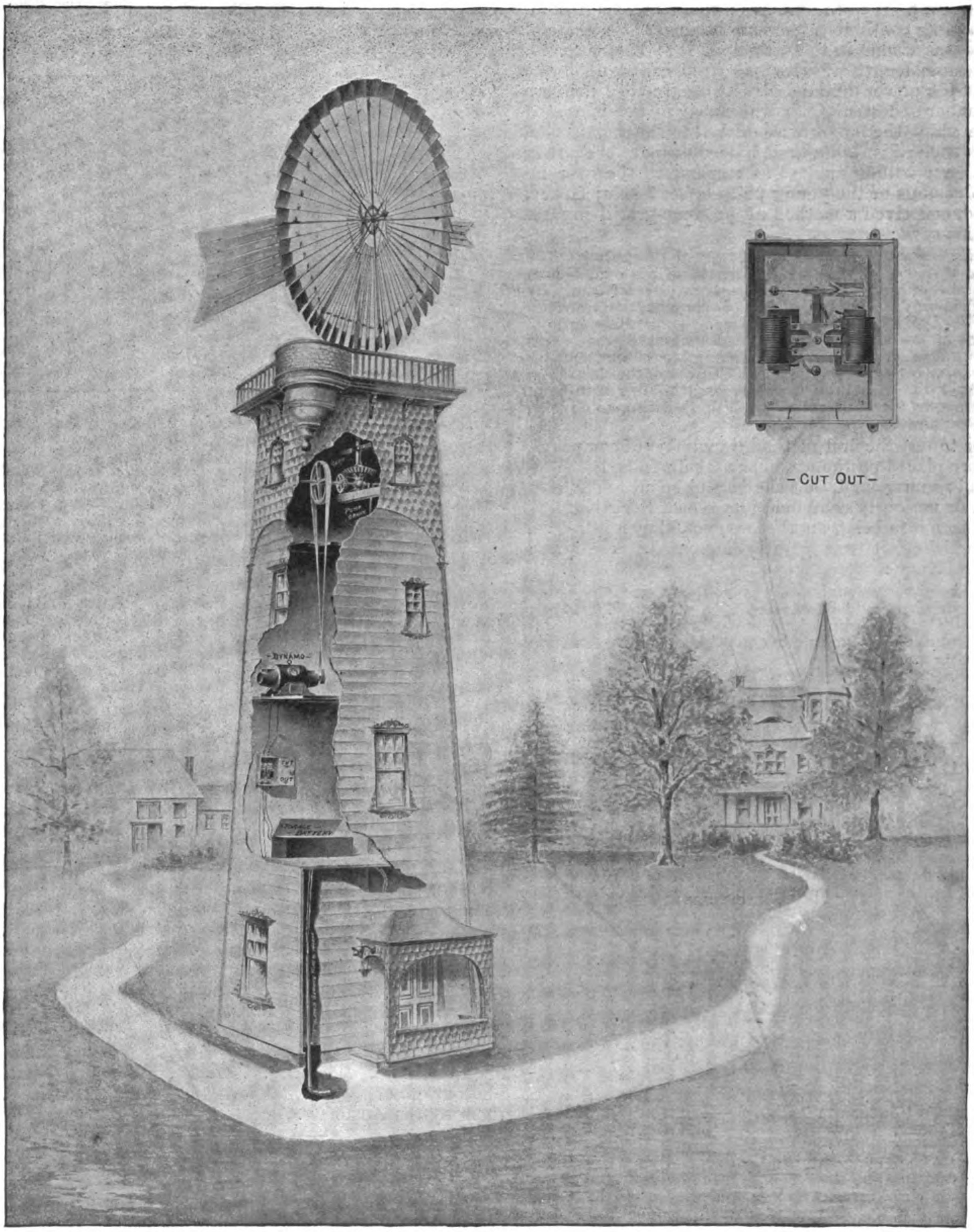
[2] "Scientific Writings of Joseph Henry." Vol. II, p. 430.

THE LEWIS SYSTEM OF ELECTRIC LIGHTING BY WINDMILLS.

In our issue of Jan. 17 we described the Lewis system of lighting railway cars in which special provision had been made to insure proper working for all rates of speed at which a train moves. Evidently the conditions here involved, so far as variation of speed is concerned, are identical with those obtaining in the operation of windmills, and hence it was but a step, and a very easy one, to adopt the Lewis arrangement to the storage of current generated by wind-power. The problem, indeed, was considerably simplified inasmuch as the arrangement which had to be made in the case of the car lighting system to allow for the reversing of the car's motion, became entirely negligible in the case of the windmill, the motion of which is always in the same direction.

In order to test the practicability of the system, the Lewis Electric Company have installed such a generating plant



The Lewis System of Electric Lighting by Windmills.

in one of the windmills at the works of Mr. A. J. Corcoran, Jersey City, N. J., the well-known builder of windmills, and during a recent visit of the writer to these works the operation of the system was demonstrated to its fullest advantage. The simplicity of the plan is well shown in the accompanying engraving which illustrates such a plant in all its details. The dynamo driven by belt from the main gear, charges a set of storage batteries. It is so designed that throughout the wide variations of speed of the windmill it maintains the potential constant. The automatic switch, which constitutes the only auxiliary apparatus in the entire system, is so arranged as to close the circuit to the battery when the dynamo speed is such as to generate an E. M. F. equal to the counter E. M. F. of the battery. At this point the cells begin to be charged and as soon as the dynamo pressure falls below the required potential, the cut-out acts so as to prevent the battery from discharging through the dynamo. The switch is so designed that it opens and closes the circuit when the current itself is at zero, and hence no sparking occurs at the contact points, while the brushes on the dynamo remain fixed under all conditions of working.

The Corcoran mill at Jersey City has a diameter of 18 feet and at a speed of 20 miles an hour is capable of delivering 3 h. p. The dynamo is driven by belt in the manner shown, having a maximum current capacity of 35 amperes at 35 volts and is cut into action when the speed is 600 rev. per minute, that is, when an 8-mile breeze is blowing. The machine is of the iron-clad type, entirely enclosed and occupies a floor space of only 30 inches square and 15 inches high.

The plant, though merely an experimental one, has operated without a single mishap from the start and the storage cells furnish current for 24 incandescent lamps distributed through the work shops.

The smoothness of working and the evident reliability of the entire arrangement leave little room for doubt that we shall see a wide application of this system.

THE TESLA CONDENSER-MAGNET.

In electric apparatus or systems in which alternating currents are employed, the self-induction of the coils or conductors in many cases operates disadvantageously by giving rise to false currents which often reduce the commercial efficiency of the apparatus or operate detrimentally in other respects.

The effects of such self-induction, as is well known, can be neutralized by proportioning to a proper degree the capacity of the circuit with relation to the self-induction and frequency of the currents. This has been accomplished heretofore by the use of condensers applied as separate instruments. In order to avoid the employment of condensers, which involve additional expense, Mr. Nikola Tesla has devised a method of constructing the coils themselves so as to accomplish the same object as the condensers.

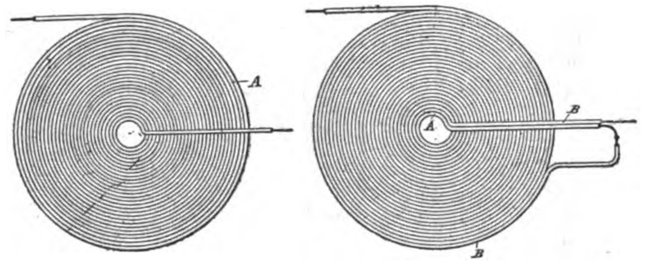
Mr. Tesla had found some years ago that in every coil there exists a certain relation between its self-induction and capacity that permits a current of given frequency and potential to pass through it with no other opposition than that of ohmic resistance, or, in other words, as though it possessed no self-induction. This is due to the mutual relations existing between the special character of the current and the self-induction and capacity of the coil, the latter quantity being just capable of neutralizing the self-induction for that frequency.

It is well known that the higher the frequency or potential difference of the current, the smaller the capacity required to counteract the self-induction; hence, in any coil, however small the capacity, it may be sufficient for the purpose stated if the proper conditions in other respects be secured. In the ordinary coils the difference of potential between adjacent turns or spires is very small, so that while they are in a sense condensers, they possess but very small capacity and the relations between the two quantities, self-induction and capacity, are not such as under any ordinary conditions satisfy the requirements contemplated by Mr. Tesla, because the capacity relatively to the self-induction is very small.

In order to attain his object and to properly increase the capacity of any given coil, Mr. Tesla winds it in such a way as to secure a greater difference of potential between its adjacent turns, and since the energy stored in the coil —considering the latter as a condenser—is proportional to the square of the potential difference between its adjacent convolutions, it is evident that in this way he may secure, by a proper disposition of these convolutions, a greatly increased capacity for a given increase in potential difference between the turns. The accompanying drawings show the general nature of the plan which he has adopted for carrying out this idea

Fig. 1 is a diagram of a coil wound in the ordinary manner, while Fig. 2 shows the winding designed to secure the objects Mr. Tesla is aiming at.

In Fig. 1, A designates any coil the convolutions of which are wound insulated in the usual way. Let it be assumed that the terminals of this coil show a potential difference of 100 volts, and that there are 1,000 convolutions; then considering any two contiguous points on adjacent convolutions let it be assumed that there will exist between them a potential difference of one-tenth of a volt.



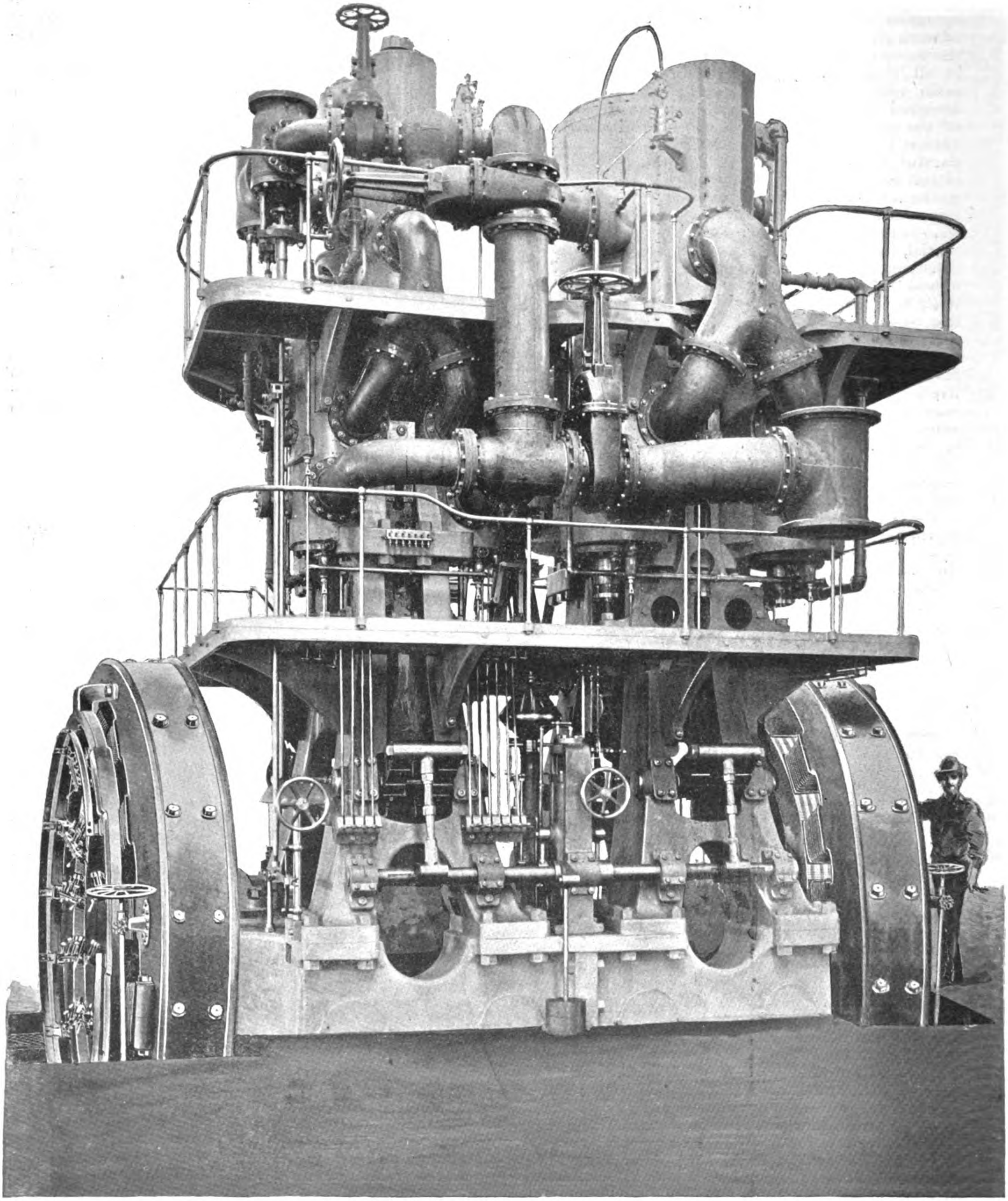
FIGS. 1 AND 2.—THE TESLA CONDENSER-MAGNET.

If now, as shown in Fig. 2, a conductor B be wound parallel with the conductor A and insulated from it, and the end of A be connected with the starting point of B, the aggregate length of the two conductors being such that the assumed number of convolutions or turns is the same, viz., 1,000, then the potential difference between any two adjacent points in A and B will be 50 volts, and as the capacity effect is proportional to the square of this difference, the energy stored in the coil as a whole will now be 250,000 times as great.

Based on this principle, any given coil may be wound either in whole or in part, not only in the exact manner illustrated, but in a great variety of ways, so as to secure between adjacent convolutions such potential difference as will give the proper capacity to neutralize the self-induction for any given current that may be employed. Capacity secured in this particular way possesses an additional advantage in that it is evenly distributed, a consideration of the greatest importance in many cases, and the results both as to efficiency and economy are more readily and easily obtained as the size of the coils, the potential difference, or frequency of the currents are increased.

THE TROLLEY AND INSURANCE.

The New York Board of Fire Underwriters' special committee on electrical hazards called upon Mayor Gilroy recently and protested against the introduction of the trolley upon Manhattan Island, also warning the Mayor that if the trolley was introduced the inevitable result would be an increase in fire insurance rates.



THE NEW VAN VLECK ENGINE AND GENERAL ELECTRIC GENERATORS IN THE ELM STREET EDISON STATION.

THE VAN VLECK 3,000 H. P. ENGINE.

The latest addition to the engineering features of the Edison Electric Illuminating Co. of New York is a very interesting engine of large size which has recently been put in operation at the Elm Street Station. The engine has cylinders 26, 37, 52 and 72 inches in diameter, with a common 36-inch stroke. Its speed is 90 revolutions, and with 200 to 210 pounds pressure it will develop from 2,500 to 3,000 h. p. The engine was built by The Dickson Mfg. Co., of Scranton, Pa. and is directly connected to a pair of 800 K. W. multipolar dynamos, one at each end of the engine. The armatures are placed directly on the overhanging ends of the engine shaft and no "outboard bearings" are employed.

The dynamos were constructed by the General Electric Company, and are the largest low tension direct current machines yet built; and although each machine has only half the capacity of the famous 1,500 K. W. General Electric railroad generators, they compare favorably with the railroad generators in point of size, the diameter over the field ring being 14 feet, and that over the armature 10 feet. The dynamos are of the common external field type with Gramme wound armature, and the commutator is a part of the bar windings on the armature face. Experience has shown that this type of machine is most satisfactory and specially adapted to the practice of omitting the outboard bearings, which are most undesirable when space is limited. They are also in the way when it becomes necessary to remove an armature. The armatures weigh about 24 tons each and alone serve as fly wheels for the engine.

The engine possesses many of the characteristics of the former engines built by the Dickson Company on what is known as the Van Vleck disconnective type. Its essential difference is, however, that it is a two-crank tandem quadruple engine instead of a three-crank triple engine. The selecting of the two-crank design, in lieu of the three crank, was induced principally by the desire to economize in floor space, and the result attained is most noteworthy in that the area occupied by the engine base, including the overhanging bearings, gives about 10 h. p. per square foot. The engine bed itself, exclusive of the projecting bearings, is 14 feet 6 inches long and 13 feet 8 inches wide.

On the other hand, the large 2,500 h. p. quadruple expansion engine, which recently attracted so much attention at the World's Fair, occupied a floor space about 37 feet by 40 feet, and gave therefore only about 1⅓ h. p. per square foot. The World's Fair engine also required a much greater area for the belts to extend over to drive the independent dynamos, whereas in the case of the engine illustrated there are no belts, and both the dynamos only occupy an additional area of 160 square feet.

It is claimed by Mr. Van Vleck, that engines will become more and more compact when engineers realize more fully, that a compact engine can be built at no greater cost and will be just as economical to operate as the engine that occupies several times as much space as is necessary.

In the case of the engine and generator here shown, a very large amount of building and real estate investment is saved and the capacity of the station is very nearly doubled by employing a two-crank instead of a three-crank engine.

The engine, as will be seen, consists of two sets of tandem cylinders mounted on the customary marine A-frames; the "high" and "first medium" cylinders comprise the left hand engine, and the "second medium" and "low" cylinders the right. The piping is so arranged that either the right or left engine can be operated without the other. When the "high" left-hand engine is used alone it exhausts past the "low" or right hand engine; but when the "low engine" is used only, it is supplied with steam past the "high engine," through a reducing valve.

The steam chests are on the engine front, as is the case with all the Van Vleck engines, making a very short engine facilitating the operation of the valves. The "high" and "second medium" cylinders are provided with one valve, and the "first medium" and "low" cylinders with two valves, the lower of which are not placed directly under the upper ones, but on each side so that they can be removed without in the least interfering with the upper valves. This feature is the invention of Mr. J. W. Sargent, M. E., and is a very valuable departure in the construction of inverted cylinder tandem engines.

The valves are all of the well known piston type and are double-ported. They are operated by a well designed Joy valve gear, controlled by a hydraulic governor, which regulates the steam for all four cylinders, and is so arranged that the speed of the engine can be varied while the engine is running. The cylinders are all provided with "liners," and are steam jacketed. The cylinders are also provided with suitable relief, drip and starting valves, which are all controlled by levers placed at the front. The cylinder covers and the piston heads are of cast steel of the marine cone design, which is considered a great advance over the ponderous cast iron piston heads which are still used so much on land.

The engine is provided with a screw and a lever throttle valve, the two placed in series in the main steam supply. The main shaft is of hammered steel and is bored hollow, both through the shaft and crank pins. The shaft is 18 inches at the ends and 16 inches in the centre. It is built in two halves and coupled in the middle. The crank pins are 16 inches in diameter and 18 inches long and are forged solid with the crank blocks. The cranks are provided with counterweights.

The main shaft journals are constructed so that the lower boxes can be removed without lifting up the shaft. The end bearings are 40 inches long, and the two centre bearings are 20 inches long, the employment of the Joy valve gear giving great length of bearings for a given length of shaft. The length of the shaft over all is 28 feet 5 inches.

The height of the engine from the floor line, is 25 feet, and, as will be noted, the engine is provided with two tiers of platform. A very complete system of oil pipes and oil tanks is provided, so as to reduce the labor of oiling as much as possible. The engine can be operated by one engineer and one oiler, and the dynamos need only the occasional attention of a dynamo man. The production of 1,600 kilowatts can therefore be carried on at a very low cost, compared with the old fashioned method of employing numerous small machines.

Most of the important details of the engine were laid out by Mr. J. W. Sargent from the specifications and advice of Mr. John Van Vleck, in consultation with Mr. H. J. Smith and other members of the Illuminating Company's staff. The drip piping, starting valves, and some other details, were worked out by Mr. R. W. Rowley of the Dickson Mfg. Co.

There are installed in the Elm Street Station, two 1250–1500 h. p. triple engines, and two 625 h. p. triple engines on the Van Vleck three-crank type. Three of the 625-engines are also installed at the Twenty-sixth Street Station, and one at the Schenectady Works of the General Electric Company.

The steam piping for the engines at the Elm Street Station has been designed and constructed with great care for a working pressure of 225 lbs. per square inch. It is probably the heaviest piping in the country, and a complete new line of valves and fittings has been especially developed for it, as the ordinary valves and fittings have been found to give a good deal of trouble when subjected to modern high pressure requirements; the adoption of high pressure having been dictated not only from economy, but for the placing of great power in a small space.

OBITUARY.

HEINRICH HERTZ.

The brief mention made in our last issue, of the death of Heinrich Hertz, on Jan. 6, will have called forth feelings of sorrow and regret among all who have followed the later progress in electrical research and application. At the age of 36, Hertz has been removed from a field of activity which he has stamped indelibly with his genius and with which his name will always be connected as a pioneer.

Hertz was born at Hamburg and up to his twenty first year he had devoted himself entirely to engineering, graduating at Berlin, where he shortly afterward took up the study of physics under Helmholtz and Kirchhoff. His abilities were early recognized by Helmholtz, whose assistant he became and with whom he remained until 1883 when he became "privat-dozent" at the University of Kiel. In 1885 he was offered the professorship of physics at the Technische Hochschule at Karlsruhe, and in 1889 he succeeded the celebrated Clausius in the chair of physics at the University of Bonn,—no small honor indeed, and especially in Germany, for a man of 32.

Although his work was by no means confined to the electrical field it is on his electrical investigations that his great fame is founded. His first work to attract general attention was an investigation into the effect of the ultra-violet rays on the electric discharge, published in 1886. In the year following he took up a series of investigations the outcome of which was the wonderful experiments that at once made his name famous and that offered the long sought for experimental demonstration of the wave lengths, and the speed of propagation, of electric vibrations, and their identity with luminous vibrations.

It is rare, indeed, that a work so fundamental in character as that of Hertz has found the immediate and universal acceptance which was accorded to it, but the logic of Hertz's arguments and the experimental proofs left no room for doubt or hesitancy. Great as has been the influence of his work in the short period which has elapsed since its promulgation, the importance of its ultimate results can scarcely be overestimated.

PERSONAL.

MR. J. M. MOFFATT, E. E., formerly in charge of Western Union quads and of subway tests, from "195," is now the electrical engineer of the Erie and Wyoming Valley Railroad Company, with his headquarters at Dunmore, Pa. He has charge of all their telegraph, telephone and electric light and power work, for which his long experience and wide reading eminently fit him.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, Philadelphia Representative, 1018 Chestnut Street, } W. F. Hanks.

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.
United States and Canada, - - - - - - - - per annum, $3.00
Four or more Copies, in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* The Electrical Engineer. *Communications for the attention of the editors should be addressed,* Editor of The Electrical Engineer, 203 *Broadway, New York City.*

Vol. XVII. NEW YORK, JANUARY 31, 1894. No. 300.

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ELECTRIC WINDMILL PLANTS.

THE utilization of what are termed the waste forces of nature is steadily pushing itself to the front, and engineers have been compelled to study applications which were scarcely even contemplated ten years ago. The ready means which electricity places in the hands of the engineer have not been overlooked and as soon as the storage battery became a commercially available apparatus a new impetus was given to the realization of long-meditated schemes. The first of these ideas to be taken up seriously was the transmission of the powers of water falls, the progress in which presents a remarkable record, of which our readers have been kept well informed. These powers, from their uniform and steady nature, afforded a favorable opportunity, but the intermittent powers of nature such as the rising and falling tides, the waves, and especially the wind, have up to the present absorbed the attention of but a few isolated workers, or indeed enthusiasts, and schemes for their utilization have been looked upon by engineers as more in the nature of fads, than as legitimate engineering work worthy of close and serious investigation.

Leaving out of consideration the utilization of the tides and waves, it seems worth while to inquire whether the power of the wind cannot be employed for the generation of electric current?

We venture to say that few have ever stopped to consider the great and rapidly increasing number of windmills now in operation and the work they are doing, principally in elevating water for drainage, irrigation, and domestic purposes. Their number in this country alone runs into the tens of thousands, and the size and powers called for are constantly increasing.

Among the very few who have taken up the utilization of wind power for electrical generation are Mr. C. F. Brush, of Cleveland, Ohio, and Prof. Blyth, in England, the former of whom, especially, has fitted up quite an elaborate plant. It must be evident however, that if this method of operation is to come into general use it must be reduced to the simplest possible arrangement, and to lack of this important feature of simplicity may be attributed the reluctance hitherto manifested by manufacturers as well as users to embark in this work. The three elements upon which success in this field depends, that is, the windmill, the dynamo and the storage battery, will be conceded to have all arrived at that stage which is called commercial, so that there can be no further question as to reliability. The only other factor then is the wind itself and on this point also sufficient data are at hand to base calculations upon. While the maximum and the minimum rate, of course, vary during different hours of the day and with the locality, an average rate of 7½ miles per hour can be depended upon in the United States. Near the sea coast and in elevated localities the average rate is much higher and it is in such situations that we shall probably see the first attempts made to apply the plan. The simplicity of the methods embodied in the Lewis system, described elsewhere in this issue, will go far towards bringing about a trial of this method by many who have long looked for an outfit of this kind that did not require the services of an expert mechanic and electrician.

A NEW PHASE IN INCANDESCENT LAMP LITIGATION.—THE BEGINNING OF THE END?

If the framers of Section 4887 of the Revised Statutes—now so familiar to our readers—had taxed their brains to imagine all possible consequences of that absurd provision, they would certainly never have hit upon the state of affairs created by Judge Ricks's opinion of last week, dissolving the injunction upon the Buckeye Electric Company, granted last July in the suit of the Edison Electric Light Company (General Electric Company). The decision is printed in full elsewhere in this issue. It sets the Buckeye company free at once; it seems not to be appealable, but may go to a final hearing of the suit before Judge Ricks some time in the future, with small, if any, likelihood of a different outcome. The Court did not pass upon the question of the expiration of the United States patent November 10, 1893—the end of the term of the English patent—nor did it consider the legality of the action of the Patent Office in affixing to the patent, upon the petition of Edison and the Edison company, in 1883, the correction reciting previous foreign patents and limiting the term of the domestic patent by that of the foreign patent having the shortest time to run; but, says Judge Ricks: "*Whether the Patent Office was authorized by law or not to make such official correction, the petitioners unquestionably had the legal power to voluntarily fix a limit upon the duration of their own patent.*" Further, the Judge says:

> "But the public, and those interested in the duration of the patent, had the right to accept complainants' statements as to the date of those foreign patents, and to act accordingly."
>
> "The application for the Edison Patent was filed Nov. 4, 1879, and the patent was granted Jan. 27, 1880, so that by the admissions of their petition the British Patent was both applied for and granted between those dates and expired between Nov. 10, 1893 and Jan. 27, 1894. The complainants cannot object because the defendant acted upon those representations. If complainants had taken no action whatever, but had relied upon their legal rights as they might be subsequently defined, the public would have acquired no advantages by the proceedings now under consideration. The defendant would have acted at its own peril, and have had no claim such as they now assert. The complainants' conduct and public declaration of the facts concerning their patent are binding upon them, and they cannot now be heard to say that they were made in doubt as to their legal rights, and made in such uncertain terms as to put the defendant upon examination as to the facts and the law, and to be bound by its proper interpretation of them."

The Court thus holds that, whether the Edison patent had or had not any legal existence after November 10, 1893, as against the Buckeye company it is of no avail after that date, the defendant having taken the voluntary act of the complainants, limiting their monopoly by that date, in good faith, and having acted upon it in planning their business and increasing their investment of capital in the manufacture of incandescent lamps.

It is difficult to see why the same reasoning will not apply in the cases of other lamp manufacturers, many of whom are in a position similar to that of the Buckeye company in respect to the merits of the question determined by Judge Ricks. The Buckeye Electric Company has been the first to bring that question to an issue in court. It has thus freed its own hands and established a precedent that may reasonably be expected to benefit all other lamp makers, to say nothing of its indirect benefit to all branches of electrical industry related to electric lighting.

The Electrical Engineer likes to see meritorious patents and obvious rights maintained at all times, but has never entertained the opinion that the suppression of all incandescent lamp making, except that of the Edison company and its successors, would be just or equitable under the circumstances of the Edison patent. We have before directed attention to the *obiter dictum* of Judge Wallace, July 31, 1891, on the occasion of settling the terms of the decree in the case of the United States Electric Lighting Company. Referring to the vagueness of the patent,

> His Honor said he thought that the greatest cloud that hung over the patent was in its claims—in the language of the patent itself. He did not much blame any infringer for assuming that he could go on and make any sort of an incandescent lamp without fear of that patent. . .

That remark of the Court, nearly three years ago, doubtless fairly represented the opinion of the patent held by the people who had put their money and brains into the manufacture of lamps in competition with the Edison company. Moreover, the long term of years which the Edison company suffered to pass without action in enforcing their claims created a presumption against the patent.

The effect of Judge Ricks's opinion is to declare the Edison patent inoperative after November 10, 1893, not because under Section 4887 it expired on that date, but because its owners said it would, and solemnly notified the public, over ten years ago, that the patent would expire then and allowed that notice to stand nearly ten years.

Section 4887 cuts a figure at every stage of the proceedings taken by the Edison people—in filing their petition of 1883 to the Patent Office, requesting the limitation of the patent, and in their petition of last March for the cancellation of their former action—while the decision of Judge Ricks is quite outside of any interpretation of that inconvenient and troublesome statute.

ELECTRICAL "PRIVATE VIEWS."

The workings of no kind of public service are so little understood by the public, even in these days when everything is written up in popular form, as those employing electricity. This is notably the case with the telephone exchange service. Misconceptions are very common as to the apparatus and employees that come in between the parties to telephonic conversations. Any intelligent effort to remove some of these misconceptions is to be applauded, and an interesting example comes to hand in the novel policy recently inaugurated by the management of The Metropolitan Telephone & Telegraph Company in inviting its subscribers and their friends to view the new central office in Broad St., New York. A few days after the exchange was opened a general invitation was issued to the Broad street subscribers. During the two afternoons appointed nearly 500 telephone users made a tour of inspection under the guidance of the company's staff. The usefulness of such an object lesson was abundantly illustrated by the comments of the visitors, most of whom were entirely unprepared to encounter such a display of highly finished and intricate apparatus, or such a numerous and industrious operating force. Many subscribers resolved on the spot, after watching an operator handle half a dozen calls in ten seconds, never to swear at "central" again, and some even declared that they would cease grumbling about the rates, so obvious did it appear that there really were other items in the cost of telephone service besides the set of instruments at the subscriber's station.

THE TELEPHONE PATENT SITUATION.—III.

The telephone receiver being free and a non-infringing transmitter possible, how may the the telephone be supported on its hook without infringing one or more of the telephone switch patents? There are more than one hundred patents on telephone switches, a large proportion of which are upon automatic switches and supports. The Bell company has had seventeen years' possession of the telephone field in which, leisurely and carefully, to make experiments, take out patents of its own and purchase the patents of others at practically its own price. In no department of the art, perhaps, has the company shown greater skill and better judgment than in the protection of the automatic telephone support. The most famous of the support patents, if not the most inclusive, is that of Hilborne L. Roosevelt, dated May 27, 1879, and numbered 215,837. This patent covers broadly the class of telephone supports by which the relations of circuits are changed through the action of the weight of the receiver when upon its support, against a spring—the circuit being in one condition when the telephone is in use and in another when it is hung up. The claims of this patent are as follows:

1. The combination, with a telephone, of a circuit closing or changing portion and screws or points, the circuit-closing portion being arranged to be placed in contact with one screw-point through the influence of the telephone when not being used, and to be placed in contact with the other screw or point when the spring is freed from the influence of the telephone, substantially as described.

2. The combination of a spring-switch, connecting-wire connected therewith, and a transmitting-instrument suspended thereto, substantially in the manner described, whereby the raising of the transmitting-instrument causes the spring-switch to make or break or alter the electric circuit.

3. The combination of a spring-switch and connecting-wire connected therewith, and a transmitting-instrument suspended thereto, combined and connected together, substantially as herein described, whereby a circuit is made through a signaling-instrument when the weight of the transmitting-instrument is on the switch, while the circuit is closed through the transmitting-instrument itself when its weight is removed from the switch.

4. A transmitting-instrument hung on a spring-switch, which spring-switch has two points, the lower one dead, the upper one making a contact with the ground, combined with another transmitting-instrument suspended on a similar switch, which switch has its lower point connected with a signaling-instrument, and its upper point connected to the transmitting-instrument, substantially as described.

5. The combination of a suspended transmitting-instrument, spring-switch, and connecting-cord independent of the connecting-wires, whereby the weight of the transmitting-instrument is taken from the wires, substantially as described.

6. The combination of two telephones, connecting-wire, and battery, and two spring-switches, connected and combined substantially as described, whereby when the weight of the telephones rests on the spring-switches a through-circuit is made by means of the battery through the signaling-instrument, while when the telephones are raised a circuit is made through the telephones and the battery is cut out.

7. The combination of a connecting-wire carrying an electric circuit, and attached to the spring-switch having contact-points, and a transmitting-instrument suspended to said spring-switch, connected and combined substantially as described, whereby the weight of the transmitting-instrument upon the switch causes the switch to complete a circuit through itself, and to a ground or a signaling instrument, while when the transmitting-instrument is raised a circuit is made through said transmitting-instrument.

8. A telephone having two connecting conducting-cords and one suspending non-conducting cord, the said non-conducting cord being shorter than the two conducting-cords, whereby the weight of the telephone is taken from the conducting-cords and rests upon the non-conducting cord, substantially as required.

The patent of which the claims are quoted above has but two years to run from May 27, 1894—or in other words, it will expire on May 27, 1896. In the most important claims of this patent—the first, second, third and fourth—the term "transmitting instrument" is employed instead of "telephone" in all but the first claim. The intention of the patent, however, is entirely clear and it is doubtful whether splitting hairs on the part of those who would infringe or evade the patent on this ground would be successful before a Court. The next important and broad patent upon telephone support switches is that of Geo. M. Phelps, of December 2, 1879, numbered 222,201. It will be noticed that while there are only three claims, no words are wasted, and the claims cover absolutely all that class of telephone supports in which a circuit-changing telephone switch is operated positively in both directions by the removal from, and replacement of, the telephone in its support. There are many subsequent patents subsidiary to this one just as there are many patents subsidiary to Roosevelt's. The following are the claims in full of the Phelps patent:

1. A circuit-changing telephone switch-lever actuated positively in both directions by the removal from or replacement of the telephone in its support, substantially as hereinbefore set forth.

2. The combination, substantially as hereinbefore set forth, of the telephone supporting hook, the pivoted forked switch-lever, and the circuit-changing switch-pieces or contact-springs mounted thereon.

3. The improved telephone-switch hereinbefore described, consisting of the combination of the supporting-hook, the pivoted forked switch-lever, its contact-springs, and the circuit-wires, whereby the circuit-changing is positively controlled by the removal from or replacement of the telephone in its support.

The next stroke of genius on the part of the Bell Company—or rather Western Electric Company—in the matter of supports was in securing control of the patent of Ezra T. Gilliland, of May 31, 1881, No. 242,195. After the patents of Roosevelt and Phelps there seemed to be only one important variety of hook to be covered, and that was the fixed hook in which the telephone when supported was shunted out of circuit by the mere contact of the eye carried by the receiver with its support when hung thereon. The claims of this patent, however, do not seem to be quite so inclusive as those of its two predecessors. There are forms of hook support not covered by these claims, which, it would seem, might as well have been included as not. The claims are as follows:

1. A telephone apparatus comprising, in combination with a telephone and its support, one or more contact-pieces carried by the telephone and electrical connections, as indicated, whereby, when the telephone is on its support, the current passes through the latter without passing through the telephone, substantially as described.

2. The combination of a telephone, an eye or equivalent device carried by the telephone and electrically connected with one or both the binding-posts, and a supporting hook or pin, substantially as described.

3. The combination of an electrical circuit, a transmitter, a hand-telephone, a support for the hand-telephone, a contact-piece carried by the telephone, and electrical connections, substantially as described, whereby the hanging of said telephone on its support cuts both itself and the transmitter out of the circuit, as set forth.

4. A telephone provided with an eye or equivalent device electrically connected with one or both binding-posts, as set forth.

It will be noticed that a telephone carrying a contact piece which is not in electrical connection with either of the binding posts is clear of the second and fourth claims. Again, if the telephone so arranged hangs upon its support in such a manner that the current is divided, say, equally between the support and the telephone, the device is also obviously clear of the first claim, which definitely specifies that when the telephone is on its support the current passes through the latter without passing through the telephone. In order to be clear of the remaining hook patents, however, the transmitter used must employ no induction coil for the reason that the device would then fall under the shadow of the great patent of Thomas A. Watson, of January 9, 1883, No. 270,522, the claims of which are as follows:

1. In combination with suitable contact-points and springs electrically connected with the *call-circuit* and the primary and secondary circuits of a transmitter, the latter circuit including the hand-telephone, a lever electrically connected with the main line in a telephone-circuit, substantially as described, to bring in the hand-telephone and transmitter and *break the call-circuit*, or to cut out the hand-telephone and transmitter and establish the *call-circuit*, accordingly as the lever is moved in one direction or the other.

2. In combination with suitable contact-points and springs

electrically connected with the call-circuit and the primary and secondary circuits of a transmitter, the latter including a hand-telephone, a lever electrically connected with the main line and provided with a hook to support the hand-telephone, and a spring tending to overcome the weight of the hand-telephone, substantially as described, to bring in the hand telephone and transmitter and break the call-circuit, or to cut out the hand-telephone and transmitter and establish the call-circuit, accordingly as the hand-telephone is removed from or hung upon said hook.

3. In combination with suitable stops connected with the primary and secondary circuits of a transmitter, the latter including the circuit through the hand-telephone, a lever electrically connected with the main line and adapted to support the hand-telephone, and provided with a spring tending to overcome the weight of the hand-telephone, substantially as described, to complete the local circuit through the transmitter, and at the same time connect with the main line the secondary circuit through the transmitter and hand-telephone by taking the hand-telephone from the hook.

4. In combination with a magneto-generator, a main-line telephone-circuit and a shunt-circuit passing through the magneto-generator, the push-button U to break the shunt-circuit, substantially as described.

5. A switch-lever and contacts for connecting with the line-wire either a telephonic circuit or a call-circuit, according to the position of the switch-lever, in combination with the magneto-generator, its shunt and push-button, the said magneto-generator being connected with the call-circuit, substantially as described.

6. In a telephonic circuit, the spring-hook D, adapted to support the weight of the hand-telephone, in combination with the contact-springs s^1, s^2, and s^3, connected with the transmitter hand-telephone and a signaling-circuit, substantially as described, for the purpose specified.

7. In a telephonic circuit, the spring-hook D, adapted to support the weight of the hand-telephone, in combination with contact-springs s^1 s^3 and their connections, substantially as described, to automatically establish the primary local circuit through the transmitter, and at the same time bring into the main line the circuit through the hand-telephone and the secondary circuit through the transmitter by taking the telephone from the hook.

8. A switch-lever connected with the main line of a telephonic circuit and movable in either direction, in combination with the contact-springs, s^1 s^2 s^3, the transmitter, the hand-telephone, a signaling-circuit and suitable connecting-wires, substantially as described.

This patent, especially in connection with those of Roosevelt, Phelps and Gilliland, has been responsible for many sleepless nights to many inventors. The first claim of the Watson patent would seem to be especially productive of insomnia. The specifications and drawings would indicate that an automatic switch only was intended to be covered, yet in the first claim the inventor seems absent-mindedly not to have mentioned the fact. Those inventors and manufacturers who are preparing to go into the telephone business and who propose to use magneto call-bells may profitably direct their attention to the 4th and 5th claims of this patent.

In connection with the subject of support patents, a good story is told of an enthusiastic inventor who called recently at the office of an electrical journal, asking the opinion of one of the staff upon his invention. The newspaper man complimented the inventor upon his ingenuity but observed, "I see that you use an automatic gravity switch which, if placed upon the market, will infringe the Roosevelt patent; I would suggest that you change your device so that it will be clear of this patent and also of the other patents upon telephone supports." "Very good," the inventor replied, "I shall do so; this evening I shall take up the matter and think it over." "If you can spare the time," suggested the newspaper man, "you might think it over a little to-morrow evening also."

NOTE.—In the first section of this article [ELECTRICAL ENGINEER January 17, p. 45] Phelps's telephone patent was referred to as No. 222,201, Dec. 2, 1879. The reference should have read: No. 220,209, Sept. 30, 1879.

ELECTROLYTIC POLARITY TEST PAPER.

WE have received from Dr. Durand Woodman, analytical and technical chemist, No. 80 Beaver street, New York, some strips of electrolytic test paper for determining the polarity of electric circuits. The current from two or three Leclanché cells, or say, a a potential of about 4 volts up, is sufficient to produce a violet red color at the negative pole. Specimens of this paper can be obtained from Dr. Woodman.

SYSTEMATIC NOMENCLATURE.

A LETTER appearing in *Nature* by Prof. Geo. F. Fitzgerald and Mr. F. T. Trouton contains the following interesting remarks on the above subject.

If once for all some system of termination was settled upon (as in chemistry, for the increasing oxidation results, &c.), the coinage of words as fresh needs arose would proceed automatically on rational lines.

This might very well form the object of a special committee of the British Association.

Mr. Oliver Heaviside's system for electromagnetic matters has much to recommend itself for adoption, also, in general physics.

For example, after the plan (1) conduc*tion*, (2) conduc*tance*, (3) conduc*tivity*, we would have, in the case of radiant energy, (1) radia*tion*, (2) radia*tance*, (3) radia*tivity*.

The first is for reference in a general way to the phenomenon in question; the second refers to its amount in appropriate units in any individual case; while the third is suitable for expressing the peculiar action or factor in the phenomenon possessed by different *kinds* of bodies. Thus the radia*tance* from a hot kettle would be the total quantity of energy lost per second. The radia*tivity* would be the quantity of this per square centimetre.

With a view of examining the feasibility of this system, the following list is subjoined. Many of the words appear at first as if they would prove most awkward in practice, but remembering similar fears (which subsequently proved groundless) in electromagnetic matters, one is afraid to say they are due to more than unfamiliarity.

Phenomenon	Amount of	Coefficient of
Absorption	Absorbance	Absorbivity
Attrition	Attritance	Attritivity
Diffusion	Diffusance	Diffusivity
Emission	Emissance	Emissivity
Expansion	Expansance	Expansivity
Extension	Extensance	Extensivity
Friction	Frictance	Frictivity
Gravitation	Gravitance	Gravitivity
Heat	Heatance	Heativity
Inertia	Inertance	Inertivity
Polarization	Polarizance	Polarisivity
Reflection	Reflectance	Reflectivity
Refraction	Refractance	Refractivity
Rotation	Rotatance	Rotativity
Solution	Solutance	Solutivity

Special attention deserves to be called to inertance as a good name for mass, and inertivity for density, to rotatance for moment of momentum, and rotativity for moment of inertia.

"ON THE EDGE OF THE FUTURE"—THE VISION OF PROFESSOR HOUSTON.

As regards the future of electricity as an economical agent, Prof. Edwin J. Houston in the January *McClure's Magazine* says:

"In the nearer foreground I see a practical method for the production of electricity directly from the burning of coal. This achieved, there necessarily follows the universal adoption of the electric motor as a prime mover; the relegation of the steam engine to the scrap heap, and the almost immediate realization of the airship as a means of transportation.

"Assuming the cause of chemical affinity to lie in the unlike electric charges of the combining atoms, I see the practical realization of electric synthesis, whereby wholesome food products will be directly formed under the potency of electric affinities. I see, too, a marked advance in electro-therapeutics, whereby human life will be prolonged and its sufferings alleviated. Diagnosis and prognosis will be profoundly aided by exact electrical measurements of the various organs of the human body as regards their electromotive force and resistance. The electro-therapeutist of the future will employ electric charges and currents for restoring the normal charges and currents of the body, as well as for the stimulation of nervous or muscular tissues.

"Back of these achievements I discern a practical apparatus for seeing through a wire—i. e., a device for looking into a receiver at one end of a metallic wire and seeing therein a faithful reproduction of whatever optical images are impressed on a transmitter at the other end—even though thousands of miles intervene. I see the possible use of the step-down transformer for the preparation of a road bed or road surface by the vitrification, in situ, of clay or other suitable soil, by the intense heating power of enormous currents of electricity.

"These things I believe I see with fair distinctness. In the further background I faintly see, dimly outlined through the clouds, an apparatus for the automatic registration of unwritten, unspoken thought, and its accurate reproduction at any indefinite time afterward."

This dream of man's future is full of brightness.

MISCELLANEOUS.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—VII.

BY PROF. GEORGE FORBES.

(*Discussion.*)

Mr. J. Swinburne said the first thing that struck him on reading the Paper was not a purely electrical question, but a commercial one, and that was, what was this power going to cost? What was it going to be sold at, who wanted it, and what were they going to do with it? The cost of the power was not given in the Paper. In time it must become public property, and he could not be asking Prof. Forbes any secret, because villages and cities were being built and factories started, and he hardly imagined the 'cute Yankee was ready to build villages and start factories without knowing what the power was going to cost. This was rather a curious question, and a rather surprising one when they went into it. In most industries the power used was quite a small proportion of the cost of running a factory, whatever it might be. In others, of course, it was a very large proportion. But in such cases, for instance, as flour milling, the cost of power was really a very small proportion, and it would hardly pay to remove a flour mill to a place where power could be had cheap from a place where labor was cheap. In other cases, such as tearing up wood pulp, of course the cost of power was a much more serious matter. But in dealing with very large power plants it generally came out, unless the load factor was very good indeed, that the cost of coal was not such a serious item as they might expect. Some time ago he worked out a scheme for transmitting power from the Midlands to London, and he found it was very largely a matter of interest, for he found that the interest upon capital was so enormous when compared with the cost of coal that the cost of coal was hardly a factor to be considered at all. There was also another important question in connection with this. They wanted to know who was going to use the power. The problem was entirely different according to whether they wanted to supply small users who required one tenth of a horse power, or to run printing machines in a district like Fetter-lane, with 2 or 3 H. P., or to drive aluminum works, where they would want hundreds or thousands of horse-power. The difficulty with medium powers was to start the motors. That did not come in with large powers; it was a small detail then. Referring to the extra output from a double current, there was something in that undoubtedly, and as a matter of interest he would like to mention that the question of the transmission of power for long distances by means of double alternating current was really before electrical engineers as early as 1887. He had nothing to do with it himself, so he had all the more pleasure in mentioning that at Messrs. Crompton's they had an inquiry for a large power transmission in Australia, and they discussed a method and decided that it should be alternating. Mr. R. B. Rogers, then his (Mr. Swinburne's) assistant, suggested that the right way to do it was by double current, winding the armature all over with wire. In fairness to Mr. Tesla and others he must say that he did not think Mr. Rogers realized that this double-current plant would be self-starting, but he quite realized other advantages. But the extra output, which was one of the features mentioned by Mr. Rogers, with a little illusory when they dealt with very large machines. The next thing he ought to remark was the very high infrequency which Prof. Forbes used, an infrequency of 0.04 sec. per period. He would like to add to what Mr. Mordey and others had said about transformers. Everybody who had done much practical designing would wish to protest against the large amount of general statement in the Paper "all other things being equal," and so on. The whole gist of the matter was in the "all other things being equal." In making a radical alteration such as that the whole comparison turned on the "other things." He protested also against the introduction into a scientific Paper of "well-known facts." Whenever an author said a thing was a well-known fact he was sure to be wrong. As to the flickering of lights, one rather important point ought to be threshed out. Helmholtz was the first, he believed, to investigate the frequency which worries the eye; whether Helmholtz quoted or investigated he was not sure. Helmholtz was concerned with the frequency that worried the ear, and went on from that to the frequency that worried the eye, which he found to be a frequency of 25. It must be borne in mind that the frequency of the flickering in the lamp was always double the frequency of the current, so that would mean, according to Helmholtz, that the eye would stand an alternate current frequency of 12½. It was very curious that Helmholtz's and Forbes's results did not agree. Prof. Forbes observed a flickering at a frequency of 48, or a frequency in the lamp of 96, whereas Helmholtz said the point of limit was 25, so that there was a very large discrepancy between the observations of electrical engineers and the observations of Helmholtz. As to capacity, Prof. Forbes took a great deal of trouble to eliminate capacity from his system. He (Mr. Swinburne) could not help thinking he was wrong there. As soon as Prof. Forbes had in all these triple and double-current motors he would find he had a whole lot of consuming devices on his circuit to take up lagging current. Capacity in the mains was very much like putting a redressed circuit round the field-magnets. Mr. Crompton and he went into the question of frequency some years ago, and they advocated about the same frequency as Prof. Forbes—about 20. But on looking into the matter they found they were wrong. In the first place, the transformers came out outrageous. In the second place, a point which Prof. Forbes had not mentioned, there was the heating of the field-magnets. If they were going to use very low frequency their pole-pieces would be very broad; the peripheral angle covered was large, and if the pole-pieces were not laminated they would get very hot. If they were laminated in the direction of movement they got over the difficulty of heating due to the Foucault currents in it, but they did not get over the difficulty of the enormous hysteresis loss, and he was not sure that this was not going to be a serious difficulty.

Mr. S. F. Walker said with reference to the winking of incandescent lamps, if they used thick filaments they could make the frequency as little as they pleased. He would like to know what the cost of the culvert which Prof. Forbes described was going to be. It appeared to him that town distribution would have to come to that. At present they buried their cables, and they could not be certain what was going to happen to them. Sooner or later faults would be generated; experience in connection with telegraph lines would bear that out. Therefore, he felt confident that sooner or later subways would have to be made for town work, and the conductors would have to be carried so that a man could walk upright and examine them. Of course, the subways might be used for a good many other things. The only question was one of cost, and it was important to know what that would be. The revolving parts in Prof. Forbes's dynamos were very heavy, and the speed seemed to him to be high. He had followed the designs for the bearings and so on very carefully. They could provide for the speed, for the centrifugal force, and the twisting strain on the spindle, which was a most important matter, but there was a big difficulty when they came to provide a steel spindle which was very large, as it would have to be to stand the enormous twisting strain; they could never be quite certain what they got inside. He believed he was correct in saying that, in this country, at any rate, all machines which had such heavy moving masses as this revolved at a very much lower speed, something like one-tenth.

Mr. Ferranti said it was well known that dynamo contractors and designers from all the world over had submitted plans to the Niagara Company. It seemed to him that it would be very hard to design a dynamo which was not in every way the best from the knowledge which the gentlemen of the Cataract Construction Company had had put before them. There were, however, several important features in which the dynamo proposed was novel. One of them was the method of insulating the coils. He had not heard of any other public proposition except that of Prof. Forbes for doing it in that way. It might be interesting to know that in the provisional specification of a patent he (Mr. Ferranti) had abandoned, occurred a passage describing a very similar arrangement. He let that drop, and he thought wisely so. He had had the pleasure lately, even since the last discussion, as well as before the Paper was read, of going round some of the works on the Continent, much as Prof. Forbes and the other engineers of the Cataract Construction had done. Although he thoroughly disagreed with the general design of the machine, he recognized some details of value in it, but these were embodied in the designs sent in by Mr. C. E. L. Brown, of Baden, perhaps the man who had done most towards high-pressure work and long-distance transmission. With regard to the cooling of the bearings, it was a very general practice amongst English and Continental engineers to circulate water continually in the jacket round the bearing, which of course was preferable to throwing water on from a hose according to marine practice, but in this case he should say it would be very effective if water were always left on. There should surely be enough water at Niagara to make this possible. He considered the exciting a large plant like that in series was anything but the best arrangement; he believed the old parallel method of exciting, had many points in its favor. The question of transforming up was in practice a very awkward one. It led to many objectionable results, and was especially bad where it was combined with other dynamos working direct on the circuit at high pressure. He believed it was contemplated to make those dynamos of higher pressure than 20,000 volts; then, he supposed, the old ones would have to be rewound, remodeled, or worked on this objectionable plan. There was, he thought, a very great difference, which might not appear at first sight, between designing dynamos and building them; in fact, a thing which one made one's ordinary daily business, was very different from getting together a collection of all the information which was available in the world, and, then, without any previous knowledge of dynamo design, and especially building, and more especially running, to design a machine which was hoped to fulfil great expectations. With regard to the next point, that of the construction of the line and the voltage to be used, as he understood it, it was proposed to use an electromotive force of 20,000 volts on the assumption that, as at Deptford, there had been used an electromotive force of 10,000 volts; 10,000 volts with one pole to earth, so the safety would be equally great with 20,000 volts, and both poles insulated. He thought this was a great fallacy. If they had two cables both insulated from earth and charged in this way, it was exceedingly unstable and dangerous. If they adopted the safest method of conveying electricity, namely, by concentric cables, then the outer conductor took the same potential as that of the earth. If the two cables were separate they were liable by any accident which might occur in practice to have one put to earth. Then they would have a reversal of strains, the whole theory of 20,000 volts being as easy as 10,000 being upset, and they would have conditions which they had not provided for. Taking this pressure of 20,000 volts, the question was how to insulate it. He read in the paper that a subway had been partly built to carry the cables. The first impression upon his mind, and also the last after carefully considering it, was that that subway would be a very hot place; 10,000 volts was quite alarming enough when it got out of control; 20,000 with big horse-power at the back would, he thought, be worse. He thought it was quite possible if any fault did occur in the subway it would cause a very serious state of affairs in the whole of that subway, or, at any rate, through a considerable portion of it, and it would probably lead to the complete breakdown of the system. Next they had the question of periodicity. He could not agree with the periodicity of 16⅔ per second, or even with a periodicity of 25. He was sure there must be a considerable amount of lighting to be done. Why should this lighting be sacrificed? Was there going to be a proportionate gain in the general working of the system by using such a low periodicity? He did not think there would be. He believed the system adopted by Ganz at Buda-Pesth was a more satisfactory one to work at, somewhere about 40. It certainly rendered both arc and incandescent lighting possible, and was somewhere about the happy medium. With regard to the higher periodicity which they had heard spoken of in connection with this Paper, there were enormous difficulties in working with it. It had been spoken of as though it really was not an important thing; but there were very serious effects. In the first place, the capacity effects were much worse where they had to deal with capacity at this high periodicity, and what was much worse than that again was the magnetic retardation due to the field excited round the conductors. This would be alluded to fully in a Paper shortly to be read, and he would not further touch upon it, except to say that it was a very grave difficulty. He ventured, however, to say that so high a periodicity as 100, or even 86, as at Deptford, would be fatal to an economical working of the system. They came now to a most interesting question—how was electricity to be transmitted to a very great distance, by what method was it going to be done? Was it going to be done by alternating currents or by continuous current? He must say he did not see the faintest chance of its being done with the continuous with the present knowledge; but, at the same time, he saw very grave difficulties in the way of doing it by alternating currents.

There was one side of the question which he thought was much more important to the Institution than the periodicity, or the electromotive force, or the design of the dynamo. It was the general principle upon which the Cataract Construction Company had obtained its information. They proceeded in an exceedingly clever way. They formed a Commission, asked the greatest scientists of the day to join them, got a room at the City and Guilds Institute at South Kensington, and gave the Commission power to offer prizes, very small ones, and used other means, in fact any means, by which they could draw and collect information. He had had the pleasure of meeting some of the people who had sent in specifications. He himself did not send any. Various schemes were sent in. There were those great scientists, men they would not think of questioning, to give the thing perfect legality, and everybody thought it was a good thing. The information was not sent in by amateurs, but by people who had to make their living by building dynamos or some such articles. One firm spent at least £1,000 in doing it, and they might take it that that money did not represent the whole cost nor the value of the brains of those able men who had been engaged in working out a scheme. Nothing sufficiently satisfactory having been obtained, what was the next step? The engineers of the company were sent round to the different works on the Continent to gain information, the Company knowing full well all the time that that information was not going to be used to the benefit of those who gave it, or be adequately recompensed. It was upon the information so obtained that the designs and schemes which had been put before the Institution had been got out; it was upon the work of the world, the electrical world, unrecompensed, that the undertaking would be carried out at Niagara. He did not blame Prof Forbes, but it had been beautifully worked out by the Company, and nearly everbody had fallen into the trap.

THE DESIGN OF SWITCH CONTACTS AND BREAKS.

I HAVE been searching for some time past for rules for the design of switch contacts and breaks to suit various currents but have found no articles as yet on this subject. Can any of your readers give me any information or references on this subject?

V.

THE THEORY AND DESIGN OF THE CLOSED COIL CONSTANT CURRENT DYNAMO.—II.

BY PROF. HENRY S. CARHART.

THREE METHODS OF GOVERNING.

Assuming still practically constant speed, we next inquire into the methods employed to maintain a constant current without appreciable sparking by rocking the brushes round the commutator cylinder.

In one machine the brushes are moved automatically by means of a small electric motor and at the same time field coils are successively cut out as the brushes rock forward with a light load. A pair of brushes is used on each side and they are kept at a fixed distance apart. By these combined means the machine can be run on short-circuit with normal current and without sparking.

Another system leaves the field coils constantly in circuit but employs two pairs of brushes and varies the angular distance between the members of each pair when the brushes are moved. The movement of the brushes is effected mechanically in response to any change in the main current till the current is brought back to the normal value. In these machines the spread of each pair of brushes, or what is sometimes called the overlap of the brushes, is lessened as they rock forward toward the polar centres. Very satisfactory results are secured in this way.

In the third class of machines only one pair of brushes is used which lap over about two or three commutator sections and the regulation of the current is effected solely by the movement of this one pair without change of overlap and without disturbance of the ampere turns on the field. The brushes are moved mechanically by means of an automatic regulating device. No less satisfactory results appear to be secured by this method than by the others, while the mechanism as a whole is somewhat simpler.

I have described these three methods for the purpose of pointing out their bearing on the theory and design of closed-coil Gramme rings for constant currents. The important question is not how to get the necessary E. M. F. with such a dynamo, but how to vary the E. M. F. in response to the varying demands of the external circuit, without injurious sparking at the brushes.

The E. M. F. is controlled in all three of these methods by rocking the brushes, and the other differences in the devices are made necessary for the supression of the sparking. This brings us to a consideration of the most intrinsically interesting topic of the paper, viz., the conditions necessary to suppress sparking and the features of design required to furnish them.

SUPRESSION OF SPARKING.

If we assume that the armature is well balanced electrically and magnetically and that the brushes have a proper bearing in contact with the smooth commutator, the conditions required to commute the current without sparking are known to be as follows: With a two pole dynamo, the current is divided through the armature, one half going from brush to brush through one side and the other half through the other side. Hence when an armature coil is carried past the brush it is transferred from the one circuit throughout the armature to the other, and at the same time the current through it reverses its direction. This constitutes the act of commutation. But the sudden decay of a current through a coil in one direction and its growth to an equal value in the other gives rise to an E. M. F. of self-induction opposing the change. This E. M. F. will prolong the flow of the current on one side of the brush and will oppose it rise on the other side. Hence if the coil is short-circuited by the brush lapping over the two consecutive commutator segments to which its ends are connected, even when the coil passes the neutral plane of the dynamo, the E. M. F. of self-induction produces a local current through this coil; and when the one end of the coil slips past the brush and becomes a part of the other half of the divided circuit the current which should reverse through it meets the opposing current and breaks over the gap to the brush with a spark. Hence the commutation must not take place at the neutral plane but in advance of it, and in a field where the induced E. M. F. in the coil shall be just sufficient to offset the self-induction, and in addition reverse the current in the coil while it is passing through the brush or pair of brushes, and cause it to grow to the normal value at the instant when one end of it passes out from under the brush. The induction from the field must be sufficient to bring the one current to zero and to set an opposite one of equal value flowing in the coil, during the time it is under the brush. Then the commutation will be sparkless.

Now if the current is kept constant in strength the field induction required to accomplish the results described is approximately the same, whether the coil is short-circuited at one angle or another in advance of the neutral plane. It would appear at first thought that, unless the induction in every part of the field from the neutral plane to a point nearly 90 degrees in advance of it is substantially uniform, terrific sparking must result when the brushes are shifted far forward to vary the electric pressure to suit the requirements of the circuit; for, if the induction is in excess of the requirements to accomplish the result described in the commuted coil, then the current will circulate through it during the short-circuit, and the rupture of this on leaving the brush will cause sparking. I have illustrated this action in the following manner: Separately excite the field magnets of a machine, which can run on short-circuit even, with a forward displacement of the brushes without sparking. Then, leaving the armature on open circuit, rock the brushes forward; the sparking will increase with each advance till it becomes terrific and endangers the machine. The induction to which each coil is subjected in an excited field produces a large current in it while it is under the brush, since there is less self-induction in the coil to offset the induction from the field than there is when the machine is self-excited and working in the normal way. There is another reason to be described later.

Considerations of this kind have lead some writers to say that sparkless commutation for any position of the brushes can be accomplished only when the induction in the field is made uniform. The Statter constant current machine in England is made on this principle. Portions of the pole pieces are laboriously cut away at such points as to make the density of the lines of force entering the armature over a given angle equal. Of course a machine built in this way will permit of shifting the brushes through a considerable angle in order to vary the potential difference without introducing sparking, but while a uniform field accomplishes the result, no such uniformity is required; the same result may be secured in other ways. The first method already described weakens the field when the brushes move forward by cutting out ampere-turns in the field magnet. This reduces the induction to the proper amount at each point without changing the overlap of the brushes. It is made necessary by the very high saturation of the armature core in this machine. It has the advantage of greater economy with small loads because field resistance is cut out, but it requires a more complex arrangement of parts on the machine than suffices for the mere movement of the brushes.

THE NORTHWESTERN ELECTRICAL ASSOCIATION.

The annual meeting of the Northwestern Electrical Association was held at the Hotel Pfister, Milwaukee, on January 17, 18 and 19, as noted in our columns last week.

At the evening session Mr. W. N. Stewart, of the Siemens & Halske Electric Company, read a paper on the "Advantage of Direct Connection," describing his idea of a model central station, his plans being based on the methods employed in several European cities.[1]

Prof. D. C. Jackson of the Wisconsin University, read an interesting paper on "Essential Station Instruments"[1] that is worthy of careful perusal.

On Thursday President Paige called the members to order at 10 o'clock, and a ballot was taken resulting in the selection of St. Paul as the city in which the semi-annual meeting would be held on the third Wednesday in July. Of the 27 members voting, 20 favored the city named.

Mr. Will W. Low, president of the Electrical Appliance Company, Chicago, then read a paper on "The New Things in Electricity," holding that from the central station-man's point of view the very complete catalogues and discount sheets, together with the salesmen possessing consciences, are the best among the new things in the supply business. Mr. Low then briefly referred to the inherent excellent qualities to be found in an insulated wire, a new transformer, an alternating arc lamp, and an incandescent lamp which his company is handling, and of the merits of which natural modesty forbade him saying more. As all but one of the supply-men present,—a gloomy individual answering to the name of Bunce,—claimed to have a conscience, the paper was not discussed.

Mr. W. Forman Collins followed with a thoughtfully prepared paper on the "Economical use of Transformers,"[2] dealing more especially with the theoretical side of the question, and maintaining that the highest economy is secured when the transformers are large and few in number.

Mr. Parmelee J. Mc Fadden, of the staff of the General Electric Company followed with some interesting practical details,[1] so clearly and concisely presented that little was left for discussion.

Following the opening of the discussion, **Mr. John Schuette**, the well-known banker of Manitiwoc, related his experience in dealing with the question of transformation of currents, and his remarks were listened to with interest. He believed that the only point to consider was how to get the best results from the equipment now comprised in their plants. **Mr. E. L. Debell**, of Sheboygan, believed that for business houses where the load seldom varied, the individual transformer is the more economical, but for residences the best results are secured by using large units. The European practice of employing a bank of transformers was referred to; a suggestion made that inventors be asked to produce a practical device that would automatically cut out a single transformer when not in service, and prevent the loss following the employment of many transformers after midnight. Then the relative merits of the five-wire direct current system *versus* transformers were discussed. **Mr. W. N. Stewart** was in favor of the method comparatively new in this country but which the Siemens-Halske Company, employ in several of its European stations. Mr. Stewart maintained that there was scarcely a town represented in this association standing in need of a transformer system, that the price of copper was no longer the bugbear to be dreaded, and that the limited area covered by the present circuits would, in many cases, render it a profitable investment were the present systems displaced by the five-wire. Mr. Stewart asked the very pertinent question why the General Electric Company had not brought out and developed the merits of the five-wire system they owned and which was an extension of the three-wire system: "Five wires," he said, "can be installed more cheaply than transformers." Then followed a ploughing up of the old danger field, and many hypothetical cases of death following the handling of lamp sockets on alternating current circuits, were referred to. **Mr. Forman Collins** and **Mr. McFadden** explained how almost impossible was the likelihood of the primary current passing in on the secondary mains, as the secondary coil would burn out if the secondary fuse did not blow, which it had always been known to do. **Mr. George Mayo** thought that if there was the slightest danger to life from handling lamp sockets on alternating circuits it certainly would have been manifested long ago, for there were several hundred thousand such lamps in service. Mr. Debell referred to an accident resulting in a severe shock and burn, but admitted that the transformer was not of an improved type, but had a wooden base on which moisture often collected. Mr. McFadden explained the facts of a case wherein a defective socket and a grounding of the primary current caused serious trouble, but admitted that it was a very rare occurrence. **Mr. W. H. Thorpe** suggested methods for overcoming some of the difficulties mentioned. **Mr. Thomas Grier** stated that it was his practice to install transformers on a basis of an overload of 33⅓ per cent. and that this method had proved satisfactory. **Mr. P. H. Korst** referred concisely to the practice in several stations, and **Prof. D. C. Jackson** stated that some of the troubles referred to might have been prevented had attention been paid to well-known laws of engineering, the transgression of which always reacts unpleasantly on both pocket and physical comfort; that, usually, the better plan to follow when contemplating changes would be to call in engineering talent in each special branch of electrical work. These remarks were heartily endorsed.

At 2.30 P. M. the members again assembled and remained in session until 6 P. M. Following the call to order Mr. E. L. **Debell** of Sheboygan, read an interesting paper on "Corliss compound engines for Electric Light Work."[1]

Mr. H. C. Thom, of Madison, then stated that he had intended to prepare a paper on the subject "How Shall Members buy Supplies," but, with the permission of the president he would read two letters he had received and then follow with a paper entitled "The Trend of Electrical Investment."[1]

Hardly had Mr. Thom ceased speaking when a discussion began that lasted for two hours. **Mr. W. F. Collins** believed that the real blame for having non-paying plants rests on the men who endeavored to save the cost of the services of a competent consulting engineer, and that in some cases it might prove profitable to employ an experienced electrical engineer to overhaul the entire plant and place it on a paying basis. **Mr. Norcross** believed that only business principles should prevail in this, the crowning industry of the future; then there would be no non-paying lighting plants. **Mr. Stewart** referred to the fallacy of cutting rates. **Senator Merrill** referred to the lack of knowledge regarding the cost of a horse-power hour; **Prof. Jackson** suggested the wisdom of first determining what the current costs at the dynamo or the switch board. Then the discussion drifted off into the keeping of station accounts and the proper rate to charge for arc and for incandescent lighting, and on motion, Prof. Jackson was requested to prepare a paper "On the Best Methods of Keeping Central Station Accounts." This Prof. Jackson promised to do provided the members would send to him copies of the forms now used and such data as would assist in the preparation of the paper.[3]

Mr. John Schuette made an observation to the effect that his superintendent files a daily report, and at the end of each six months Mr. Schuette declares the dividends and divides the surplus profits among the stockholders. The appointment of a committee to recommend a schedule of prices for arc and incandescent lights was discussed and on motion carried.

The following committees were then announced, several new members added, the business closed up, and an adjournment carried.

Committee on Legislation.—H. C. Thom, Geo. Merrill, George Grimm.

Committee on Transporation.—I. P. Lord, Pliny Norcross, O. M. Race.

Committee on Entertainment.—J. C. Woodward, W. B. Baker, L. E. Debell.

Committee on Special Legislation for Underwriter's Rules.—H. C. Thom, Pliny Norcross, J. A. Andrews.

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[1] An abstract of this Paper will appear in our columns.—Eds. E. E.

[2] See page 97.

[3] It will materially add to the value of Prof. Jackson's paper if every central station manager who may read this summary of the proceedings, will send a set of forms and any suggestions that would aid in formulating a standard system to Prof. D. C. Jackson, Madison, Wis.

Committee for Preparing Rate Schedule.—Geo. A. Davis, George Farwell, P. H. Korst.

The members and their friends, to the number of nearly one hundred, attended the banquet at 8.30, and listened to the remarks of the admirable toast master, Mr. W. H. Thom and several other witty speakers.

There was also some excellent music, after which Mr. Thom made a few appropriate closing remarks, and the members adjourned to the Clubroom where they passed the next two or three hours in making the night merry.

On Friday the members and their friends were the guests of the local committees and visited the new and model shops of the Milwaukee Street Railway Company, the power house of the E. P. Allis Company, the Pabst Brewing Company, the Edison, the Siemens & Halske and the Badger local stations.

From the beginning it was a very enjoyable affair and everyone—especially the supply men—were tireless in their endeavors to promote the best interests of all; and the bonds of good fellowship were closely united among the different interests represented.

ECONOMIC USE OF TRANSFORMERS.[1]

BY W. FORMAN COLLINS.

In the distribution of electrical energy by means of alternating currents the transformer may be considered to be the key to the situation, because by its use we are enabled to so change the form of the energy as regards its electromotive force and current as to render it suitable for the operation of all kinds of translating devices and transmit it from point to point cheaply and with small loss, and it accomplishes all this for us without any rotating or moving parts, which is its most important feature of value. By considering the several features of transformers and studying the way in which they operate we can arrive at the right way to secure the greatest economy in their use. Perhaps the best way to do this is to look at the problem as follows: The actions that go on in a transformer, the losses that occur, the methods of construction and distribution.

Actions. A transformer is, to all intents and purposes, similar to a dynamo which has no rotating armature but in which, instead, the magnetic lines of force are caused to alternate rapidly by connection with a source of alternating current; an electromotive force is produced in the primary coil by the alternating source varying the magnetic lines that link through the coil; these in turn pass through the secondary coil which is in inductive relation to the primary and produces an electromotive force in it also, because the two coils are connected magnetically by being wound about the same iron core. The rate at which the magnetic lines due to the primary current are cut by the secondary coil represent a measure of the electromotive force given to the secondary. The voltage produced at the terminals of the secondary coil depends simply upon the ratio of the number of turns of the wire in each coil provided the induction is the same through both.

A transformer on an alternating circuit possesses inherently a property of inductive resistance or impedance which is similar in its action and effects to the back electromotive force of an ordinary motor which only allows the absorption of a very small current when there is no work being done by the motor, this small current being sufficient to rotate the armature and overcome the frictional and other losses. The inductive resistance of the primary acts in the same way, opposing the pressure on it and almost balancing it in a well designed transformer so that but a small current is absorbed in the primary when there is no work being done by the secondary in supplying lamps or other apparatus.

Losses. There are several sources of loss in a transformer which may be divided into two classes; magnetic losses, or those which take place in the iron, and conductor losses, or those which take place in the copper coils. The former comprise magnetic leakage, the loss by hysteresis due to the rapid reversal of the magnetism, heating of the iron core and eddy currents; the latter, the drop or loss of voltage in overcoming the resistance of the copper conductors and the energy dissipated in heat which varies as the square of the current passing. Magnetic leakage is due to the fact that some of the magnetic lines of force leak out along the core instead of passing through the secondary; this leakage effect is increased by the opposing magnetic action of the secondary to that of the primary, and the direct result is a lowering of the electromotive force of the secondary. Even when there is no load on the secondary some magnetic leakage is taking place. When the transformer is running light the primary coil absorbs current enough to produce a field sufficiently strong to balance the voltage of the primary. The current thus absorbed is termed the "idle" current and it is of course necessary to have it very small.

The iron loss is dependent on the induction, and the amount and kind of iron used. It is generally conceded to be most advantageous to have the losses in the iron as small as possible, because they are continuous and are going on all the time irrespective of the conditions of the external circuit. On the other hand the copper losses are only maximum during the periods of full or very nearly full load, which is not the general condition of the transformers, although it should be; therefore it is unnecessary to have them unduly small; furthermore the element of cost enters quite markedly into this portion of the subject. When there is no load there is practically no loss in the conductors.

Construction. It is very important to have a well designed and carefully built transformer because the coal bill will be most wonderfully affected by the employment of wasteful and inefficient apparatus. Transformers are generally built with closed iron magnetic circuit to reduce leakage and keep down the primary magnetizing current. It may be well to mention here incidentally the "hedgehog" type of transformer due to Mr. James Swinburne which uses an open iron magnetic circuit of special form.

Care should be taken to have the resistance of the coils low to prevent drop of voltage and heating, and the leakage small. To carry out the latter condition the coils should be placed preferably one surrounding the other but should not be wound so that their turns interlace or are in alternate layers. The cores must be of finely divided iron, the laminations insulated from one another to reduce eddy current and prevent heating; stampings are generally used because the manufacturing cost is thus lowered. A low induction must be employed to prevent undue heating and the iron must not even at full load approach the saturation point.

A well made closed iron circuit transformer should give a high efficiency not only at full load but also at light load. For measuring alternating currents the various dynamometer instruments and the well known Cardew voltmeters are quite accurate for practical work; although probably the most exact way is to use the electrometer which, however, is not well adapted for ordinary work as it is exceedingly delicate and requires suitable conditions and considerable skill and care in handling.

Distribution. It is quite as necessary to arrange the transformers for any particular distribution so as to obtain the most economical performance at all times as to secure transformers of high efficiency in the first place. With the primary pressure constant, as the load on the station is increased the tendency of the secondary voltage is to drop on account of the leakage and the ohmic resistance of the coils. This must be compensated for at the station so as to maintain the pressure of the secondary circuits constant to ensure good service from the arc or incandescent lamps and motors that may be connected. A good transformer, however, supplied with constant electromotive force should give very nearly constant electromotive force on the secondary for all loads within its capacity. The usual condition of a lot of transformers run from a central station is that of light load and often for a great portion of the time without any load at all. It has been observed by all operating alternating plants that with a non-inductive resistance such as incandescent lamps the drop under varying load is smallest, being greater on arc lamps or motors because of the presence of self induction in the latter, and it is even possible to have an actual rise in pressure as was experienced on the long cables of the huge Ferranti station at Deptford, England, and ascribed to their capacity action.

For running arc lamps it is not desirable to have the periodicity too low; about 50 is generally used. The average loss in distribution by alternating currents is remarkably small, about 5 to 10 per cent. divided up about equally between the circuits and transformers. Loss of energy is proportional to the square of the current employed and the weight of copper required varies inversely as the square of the electromotive force, or in other words, one-fourth of the amount of copper is required to transmit any given amount of energy at twice the pressure.

It is evident that a small converter will not be nearly as efficient as a large one because the magnetic circuit cannot be as short, relatively speaking or the copper coils as compactly arranged, and it will heat far more; it is also plain that a small converter will cost more per lamp output than a larger one. From these two most vital considerations large transformers are both cheaper and more economical and less of them are necessary. They can be just as desirably used as a number of smaller ones, by taking a little care in laying out the circuits and distributing them so as to reach as many consumers as possible with a single large transformer and its attendant advantages. At first sight it might appear as if the increased amount of copper used in the larger secondary mains would be injudicious but this is not so (provided, of course, discretion is used) because the slight additional cost of conductors is completely overbalanced by the diminution of losses in the transformers which are permanent and continuous. The regulation of large transformers is also superior; they are much lighter for their output and cost less to install. The difference in efficiency is quite marked between a 10-light converter and a 100-light one; for instance, while the former will probably have a full load efficiency of 88 per cent. or 90 per cent. the latter will be as high as 95 per cent. to 97 per cent.

Summing up the conclusions arrived at, it is apparent that to fulfill the requirements of most economical operation, transformers of the highest all round efficiency under varying load should be used and so far as circumstances permit, let them be large in size and few in number.

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[1] Abstract of a paper read before Northwestern Electrical Association, Milwaukee, Wis., Jan. 17-19, 1893.

SOME DATA ON THE COST OF TELEPHONE WORK IN NEW YORK CITY.

The Metropolitan Telephone and Telegraph Company furnish the following interesting information with regard to certain features of their New York Telephone System and the Broad Street Exchange, recently illustrated and described in our pages:—

The Broad Street Exchange, which serves the district bounded by Wall Street and Broadway from Wall Street to the Battery, is the eighth central office of the New York telephone system. It is one of the four larger offices which have been placed in fire proof buildings specially constructed to contain telephone centres. In every feature it represents the most modern development of telephone engineering, and so rapid has this development been, that in no single item of its equipment does the Broad Street Exchange resemble the equipment of a telephone exchange of four years ago.

As an illustration of the continual reconstruction of a large telephone plant that is rendered necessary by the constant improvements in apparatus and methods, produced in response to the continual demand of the public for increased telephone facilities and for perfect service, the Eighteenth Street Exchange is a case in point. This exchange was recently moved to a new building, and to effect the removal an entirely new central office equipment was constructed, and the equipment of the old office, which had been in service a *few days more than four years*, was abandoned and the greater part of it was sold as junk.

The Broad Street Exchange at present supplies telephone service to some 1,100 subscribers, all of whom have been transferred from the Cortlandt street office, which, until lately, served nearly 5,000 subscribers and was overcrowded. The ultimate capacity of the Broad street office is for 3,000 subscribers. It contains the latest type of metallic circuit multiple switchboard, a notable feature of which are the ingenious self-restoring indicators. These indicators return to their normal position automatically, thus relieving the operator of two manual operations, and consequently quickening the service.

During the past year or two, improved methods of construction of lines and the placing of underground cables have been pushed with great vigor, resulting in the removal of old overhead wires and their substitution by copper metallic circuits throughout. In the Broad street district few old style lines now exist, and not a single wire enters the exchange overhead. All the subscribers' lines are brought into the building through the basement in lead covered cables, each containing fifty metallic circuit conductors. At the ends of the cables the conductors are connected to lightning arresters, which prevent dangerous currents from reaching the switchboard apparatus. The conductors next pass through a special switchboard or connecting rack where they make their union with the wires of the operating switchboard proper. This connecting rack is designed to allow of the junctions between the subscribers' lines and the switchboard being interchanged whenever necessary, and gives great flexibility in the apparently complicated system of wires.

Special features of interest are the generating plant, where current is produced for charging the switchboard transmitters and for ringing the subscribers' bells: the desk of the "wire chief," provided with apparatus for testing the subscribers' lines and locating "troubles;" the desks of the monitor and exchange manager, which are equipped with lines running to all parts of the switchboard to enable proper supervision of the operation to be maintained.

The telephone system of New York City consists at present of eight exchanges, equipped with metallic circuit multiple switchboards, having a total accommodation for 15,000 subscribers, upwards of 9,600 subscribers' stations, 800 private line stations, and 80,000 miles of underground wire. The entire system is constructed on a basis of exclusive metallic circuit working. About sixty per cent. of the subscribers now have metallic circuit lines and equipment, and the conversion from the old style grounded lines to metallic circuits is progressing with great rapidity.

With a metallic circuit line and office equipment, a New York telephone subscriber can talk from his own desk to any one of upwards of 100,000 telephone subscribers in other cities, some of them over a thousand miles distant. This extraordinary development of telephony in America is in striking contrast with the state of the art in Europe, where subscribers can get only local service from their own instruments, and, to use a long distance line, must go to the terminus of the line, making an appointment with the distant correspondent first by telegraph.

There are between 80,000 and 90,000 conversations by telephone each day in New York City, and the average use of the telephone by each subscriber is 16 times daily. Many busy subscribers use their telephones from 100 to 200 times daily.

For the entire system there are over 400 lady operators. About 250 are on duty at the switchboards at the same time. The average number of connections made daily by each operator is a trifle under 400. At every exchange, comfortable sitting rooms, provided with lockers, tea and coffee urns, etc., are established for the use of the operators when not on duty at the switchboard.

A peculiar feature of the daily business of a telephone exchange is its enormous fluctuation. Although the service is permanent, the greater proportion of the twenty-four hours' work is compressed into two periods of about two hours each. In order to cope with these high pressure periods without delay in the service, the entire plant and personnel of the system have to be organized as if the whole of the day's work were on the same plane. Besides the operators, there is at each exchange a skilled force of electric wiremen constantly engaged in making connections and keeping all parts of the plant in efficient working order. None but skilled labor is employed in any part of the telephone system.

The working force needed to maintain the telephone service consists of about 1,000 persons, an average of one employee to every nine subscribers. The technical work is carried on by departments, each having a large force of men under a responsible head. Some idea of the amount of construction work done can be gained from the fact that during 1893 more than 8,000 lines were built and an equal number of stations equipped and more than 2,000 disconnected and removed.

SOCIETY AND CLUB NOTES.

NATIONAL ELECTRIC LIGHT ASSOCIATION.

Mr. C. O. Baker, Jr., Master of Transportation, issues the following notice:—

"The Boston Passenger Committee and the Southern Passenger Association have granted a rate of a fare and a third for the round trip from points in their respective territories to members and delegates attending the Washington Convention."

Secretary George F. Porter has sent out his preliminary circular of invitation to central station companies to attend the Washington convention. Its programme includes the following special "Topics of Discussion":—

What is the most economical Size for Arc Dynamos; Arc Lights on Incandescent Circuits; How to Rate Arc Lamps; Underground Circuits; How to Wire Buildings; Commercial Alternating Motors; Electrolytic Effects of Return Currents; Motors vs. Flat Rates; Storage Batteries.

A paper entitled "Electric Lighting at the World's Fair and Some of its Lessons," illustrated with stereopticon, by T. C. Martin and L. Stieringer; "Impressions of a Central Station Man Abroad," by E. A. Leslie; "The Importance of Complete Metallic Circuits for Electric Railways," by J. H. Vail; and other papers, subjects to be announced, are promised.

DR. BELL'S LECTURE IN THE ELECTRICAL WORKERS' COURSE.

The second lecture in the University Extension course of the Electrical Workers was delivered at Cooper Union by Dr. Louis Bell, who addressed himself to the subject of "Alternating Current Dynamos and Motors." The lecture was a beautifully simple, clear and compact treatment of the alternating current and of the apparatus by means of which it is generated and utilized, and the descriptions given carried the audience by easy, evolutional stages from the rudimentary methods of the past up to the more involved transformations of the present, and the new polyphase work on which so much depends. Dr. Bell illustrated his remarks with numerous large diagrams on the black board, and had a stageful of apparatus by way of ocular demonstration. The audience was very attentive and appreciative, and it is worthy of comment that it numbered considerably over 600—a striking testimony to the value of these popular addresses on scientific topics.

HARVARD ELECTRIC CLUB.

Mr. Thomas D. Lockwood, of the American Bell Telephone Co., gave an interesting lecture, Wednesday evening, Jan. 17, on "The Progressive Evolution of the Telephone System of To-day." The history and growth of the telephone was traced from the time of the Centennial up to the present, thus showing the gradual advances and additions that have combined to make the practical telephone of to-day. The address was illustrated by telephonic apparatus and diagrams showing the various stages of development. Several members of the Bell Telephone Company and of the American Institute of Electrical Engineers attended the lecture.

Mr. Marsden J. Perry, of Providence, the banker and electric light magnate, has been appointed a joint permanent receiver with Thomas C. Platt, of the New York and New England Railroad. The appointment gives great satisfaction in Rhode Island and Massachusetts.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

THE INJUNCTION AGAINST THE BUCKEYE COMPANY DISSOLVED.—EDISON ELECTRIC LIGHT CO. VS. BUCKEYE ELECTRIC CO.

On Tuesday, January 23, Judge Ricks, Circuit Court of the United States, Northern District of Ohio, Eastern Division, granted the motion of the Buckeye Electric Company to dissolve the injunction allowed against them July 28, 1893, in the suit of The Edison Electric Light Co. for infringement of the Edison lamp patent.

The opinion of the Court, given in full below, is preceded by an elaborate statement of the case, the main points of which were stated in THE ELECTRICAL ENGINEER, of December 20, 1893, and which may be summarized as follows:

The contention was entirely upon the legal effect, as between the parties to the suit, of the now famous certificate of correction attached by the Patent Office to the Edison patent, upon the petition of Thomas A. Edison [The Edison Electric Light Co.] of November 15, 1883; reciting certain foreign patents for the same invention and requesting that the Edison patent of January 29, 1880, be so limited as to expire with the foreign patent having the shortest time to run. Among the foreign patents named was the English patent of November 10, 1879. It was contended in support of the motion to dissolve the injunction that by the procurement of such certificate Edison and The Edison Electric Light Co. were estopped from the enforcement of their patent after November 10, 1893, the period of the English patent being fourteen years. The Buckeye Company alleged that taking the corrected Letters Patent of Edison in good faith they had largely increased their investment in the business of lamp manufacture, having no reason to doubt the expiration of the Edison patent November 10, 1893.

The Edison Co. alleged that they had committed an error in procuring the correction of the patent in 1883—that in March, 1893, they had procured the cancellation of said correction—and that the correction, during the ten years of its existence as an endorsement on the patent, was in law null and void as limiting the period of the patent.

The points of contention on both sides are so clearly set forth in the text of the opinion of Judge Ricks, that no further preliminary statement is required here.

OPINION OF THE COURT.

RICKS, J.:

It will be seen from the foregoing statement of facts that the complainants do not deny the proceedings instituted by them in November, 1883, in the Patent Office, substantially as set forth in the defendant's motion. But they contend that they are not bound by the action of the Patent Office, taken upon their petition, for several reasons; among these, and chiefly:

FIRST. Because the petition for a limitation upon the duration of their patent, filed by the complainants, and the proceedings in support thereof on their part, were taken under a mistake as to the law and as to their rights under the patent, and that this error was corrected as soon as possible after discovery.

SECOND. Because the action and orders of the Patent Office were without authority of law, of no force and validity, and, therefore, did not in any way affect the patent.

The complainants' statement of the facts under which this action of the Patent Office was invoked, admits that they were advised and believed at the time that such action was necessary in order to remove doubts as to the validity of the patent as originally issued. These doubts arose because of a decision of one or more of the Federal Courts that it was essential to the validity of a patent, where foreign patents for the same invention had been applied for, that the date of such foreign patents and their limitation should be cited in the application, so that the limitation of the American patent would appear on its face. In view of the uncertainties thus existing as to the validity of the Edison patent, because of these omissions in the application for the patent, and, to remove all doubts, the patentee and the assignee both joined in a petition to the Commissioner of Patents, in which they stated that, while the application for Letters Patent No. 223,898 was pending, said patentee applied for and obtained letters patent for the same invention in several foreign countries as hereinbefore fully set forth in the statement of the case. The petitioners further represented that, because of the omissions of such recitals in the application, the United States Letters Patent were granted to the patentee, unlimited, for the full term of seventeen years. The petitioners further say that they were advised that said letters patent, when issued, should have been limited upon their face to the term of the foreign patent having the shortest term prior to the date of the United States Patent. Thereupon, the petitioners tendered the said United States Letters Patent to the Commissioner of Patents, and requested that they be corrected according to the provisions of the first clause of rule 164. Upon this petition, the Commissioner issued the following certificate:

"DEPARTMENT OF THE INTERIOR,
"United States Patent Office,
"WASHINGTON, D. C., Dec. 18th, 1883.

"In compliance with the request of the party in interest, Letters Patent No. 223,898, granted January 27th, 1880, to Thomas A. Edison, of Menlo Park, New Jersey, for an improvement in electric lamps is hereby limited so as to expire at the same time with the patents of the following named having the shortest time to run, viz.:

"British Patent, dated November 10th, 1879, No. 4,576.
"Canadian Patent, dated November 17th, 1879, No. 10,654.
"Belgian Patent, dated November 29th, 1879, No. 49,884.
"Italian Patent, dated December 6th, 1879; and
"French Patent, dated January 20th, 1880, No. 133,756.

"It is hereby certified that the proper entries and corrections have been made in the files and records of the Patent Office.

"This amendment is made that the United States Patent may conform to the provisions of Section 4887 of the Revised Statutes.

"BENJAMIN BUTTERWORTH,
[SEAL.] "Commissioner of Patents.
"Approved:
"M. L. JOSLYN,
"Acting Secretary of the Interior."

On the sixth day of March, 1893, the complainants, as petitioners, forwarded another application to the Commissioner of Patents, in which they recited their former petition, the action taken thereon; that subsequent thereto, by decision of the Circuit Court of Appeals of the Second Circuit, said former action of the Commissioner was declared to have been taken without authority of law, and therefore void, and asking that the former correction of the records by the Commissioner of Patents be canceled. Thereupon, the following action was taken by the Commissioner of Patents:

"Now, in compliance with the request of the parties in interest, said certificate is hereby canceled, and the proper entries and corrections have been made in the files and records of the Patent Office.

"In testimony whereof, I have hereunto set my hand, and caused the seal of the Patent Office to be affixed, this 15th day of March, 1893.

"W. E. SIMONDS,
[SEAL.] "Commissioner of Patents.
"Approved:
"CYRUS BUSSEY,
"Asst. Secretary of the Interior."

What is the legal effect of these applications of the petitioner and the action of the Commissioner of Patents thereon? It is urged on behalf of the defendant that these proceedings, deliberately taken by the complainants, amounted to a voluntary dedication by them to the public of the patent from and after November 10, 1893, at which time the British Patent expired by limitation. It is contended, in reply, that, even though such action was a dedication by the complainants as claimed, it was a dedication of something which was to be given to the public some time in the future, and, long before the dedication was to take effect, it was revoked and annulled, and no rights thereby passed either to the defendant or to the public.

Was this conduct and action of the complainants an abandonment of some right, or a dedication to the public of a privilege or right conferred. The arguments on this point have taken a wide range in the briefs of counsel. The action of the complainants in this case, while in the nature of a dedication to the public of a part of the time for which the sole enjoyment of the privileges of the patent were conferred, is not in all respects like the abandonment of a part of an invention by a failure to claim all of it, or by a disclaimer in express words of a part of it. In the latter case the right of the public to at once appropriate the abandoned or disclaimed part of the invention attaches, and the patentee is powerless to prevent such appropriation. In this case the complainants did not abandon or disclaim anything that could be immediately appropriated. It was a voluntary act by which they declared a limitation upon the duration of their patent, which shortened its term. It was not, however, as complainants contend, a simple declaration that, at the expiration of the shortest foreign patent recited in their petition for correction, they would then dedicate to the public the remainder of its full term of seventeen years conferred by the United States Patent. If its legal effect was such a dedication, to take effect ten years in the future, it would have been a gift or grant, which might have been subject to revocation. But the time for which the patentee is granted the sole enjoyment of the monopoly conferred is just as much the subject of a dedication and grant to the public as a part of the invention or process. The law on this subject is well stated in Robinson on Patents, Section 845, to be as follows:

"The patent privilege is not a mere reward bestowed upon the inventor for past services, the payment of a debt of gratitude toward one who has already conferred a benefit upon the state; it is also a purchase by the government, acting on behalf of the whole people, of some new art or instrument, capable of beneficial use, for which it recompenses the inventor by securing to him for a time its sole enjoyment; and when, without this recompense, it has obtained the invention through his voluntary act, so far from recognizing him as entitled to remuneration, it unhesitatingly appropriates his invention to itself, whatever loss and difficulty may result to him."

What, then, did the complainants intend to do, and what did they think they had the legal right to do, with reference to the legal difficulties which they believed then surrounded them? There can be no doubt as to what their intentions and purposes then were. They asked for the right to limit their United States Patent so that it might expire at the same time with the patent named having the shortest time to run. They named in their petition the British Patent No. 4576, and therein stated that the said patent was dated as of November 10th, 1879. They then believed that said patent would expire November 10th, 1893, for, if they correctly stated its date, it would by law then expire. The limitation thus deliberately put upon the duration of their own patent was then believed to be necessary to its validity. Acting under such a belief of their legal relations to the public, they then fixed the limit for their patent for what seemed to them a pressing necessity and a sufficient consideration. Whether the Patent Office was authorized by law or not to make such official correction, the petitioners unquestionably had the legal power to voluntarily fix a limit upon the duration of their own patent.

Did that power depend upon future revelations as to the correctness of the legal advice under which they acted? That their proceedings were taken under a mistake of law might give them the right to correct their error by proper application, made within proper time; but such misapprehension could not affect their power or authority to make such limitation of the grant conferred upon them.

But it is contended that their petition for correction was of such an indefinite character that it put the public and all parties interested upon their inquiry as to its legal effect. It is said that the duration of the patents set forth in the petition were not stated; and to ascertain such a limitation involved investigation as to the laws of the respective countries, and that if such investigation had taken place the defendant would have ascertained that the term of the British Patent did not begin until it was sealed and granted.

But the public, and those interested in the duration of the patent, had the right to accept complainants' statements as to the date of those foreign patents, and to act accordingly. In their petition for correction they aver that they were not advised that the practice of the Patent Office required an applicant to acknowledge during the pendency of his application a foreign patent applied for and granted subsequent to the filing of such application. The application for the Edison Patent was filed November 4th, 1879, and the patent was granted January 27th, 1880, so that by the admissions of their petition the British Patent was both applied for and granted between those dates, and expired between November 10th, 1893, and January 27th, 1894. The complainants cannot object because the defendant acted upon those representations. If complainants had taken no action whatever, but had relied upon their legal rights as they might be subsequently defined, the public would have acquired no advantages by the proceedings now under consideration. The defendant would have acted at its own peril, and have no claim such as they now assert. The complainants' conduct and public declaration of the facts concerning their patent are binding upon them, and they cannot now be heard to say that they were made in doubt as to their legal rights, and made in such uncertain terms as to put the defendant upon examination as to the facts and the law, and to be bound by its proper interpretation of them. Even conceding that said petition was filed under mistaken advice as to the law, and that it asked only for such action as the Patent Office might lawfully take, and that the terms in which said action was invoked were such as to put the defendant upon its inquiry as to the law, it was nevertheless a solemn and public act, by which it limited the duration of its own patent to a term shorter than that granted in the original patent. The petition and prayer was for such a limitation, and the complainants are bound by such declaration and conduct. Can there be any doubt as to their right and power to have made such a declaration and abandonment of an existing right? Such power is clearly recognized in Insurance Co. vs. Mowry, 96 U. S., 547.

But it is said this dedication was revoked. On the sixth of March, 1893, the complainants filed their petition in the Patent Office, as hereinbefore stated, and recited further that by the decision of the Circuit Court of Appeals for the Second Circuit said action of the Patent Office was declared to be "without jurisdiction and wholly void," and for these reasons asking that the records of the Patent Office "be amended so as to cancel the said statements and limitations, and so as to restore them to the same condition in which they were at the time of the original grant of said patent;" and further, "that the said certificate of correction attached to the said letters patent be canceled so that the patent will be in the same condition in which it was originally granted." Upon this petition, the Commissioner of Patents on March 15th, 1893, ordered: "That said certificate is hereby canceled, and the proper entries and corrections have been made in the files and records of the Patent Office."

By these proceedings it is claimed that if the petition for correction, and the proceedings thereunder of November, 1883, amounted to a dedication, such dedication was then revoked, and that the patent stands as though no correction had ever been taken or made.

It is further contended that the holding by the Circuit Court of Appeals for the Second Circuit that the action of the Commissioner on the first petition for correction was wholly void, and that the surrender of the letters patent for correction was without legal authority and of no effect, should be conclusive of this controversy. But this is not a controversy in which the authority of the complainants to surrender their letters patent to the Commissioner of Patents for correction, or his power to make such correction, and amend the records of his office, are involved. The defendant is not here asserting any such power, or claiming any such result as legal or valid. It is here, however, contending that, whether the Commissioner of Patents had legal authority for his action or not, the complainants certainly had the right and power to publicly and solemnly limit the duration of their own patent and make record of their intention to abandon it to the public from and after November 10, 1893, the expiration of their British Patent. Having done so, and the defendant having, in good faith, acted on said public declaration, it now contends that the complainants are estopped from coming into Court and asserting that such conduct was a mistake as to the law, and, therefore, not binding upon them. This involves the consideration of the question as to whether the complainants' conduct was a representation as to something it proposed to do in the future, and, therefore subject to revocation, or whether it was an abandonment of an existing right. I find the exact question, as it seems to me, fairly settled by the Supreme Court in the case of Insurance Company vs. Mowry, 96 U. S., 547. In that case the Court said:

"The only case in which a representation as to the future can be held to be an estoppel is where it relates to an intended abandonment of an existing right, and is made to influence others, and by which they have been induced to act. An estoppel cannot arise from a promise as to future action with respect to a right to be acquired upon an agreement not yet made. The doctrine of estoppel is applied with respect to representations of a party, to prevent their operating as a fraud upon one party who has been led to rely upon them. They would have that effect, if a party who, by his statements as to matters of fact, or as to his intended abandonment of existing rights, had designedly induced another to change his conduct or alter his conditions in reliance upon them, could be permitted to deny the truth of his statements, or enforce his rights against his declared intention of abandonment."

But in a later decision the same Court said it is not necessary that there should be a design or a purpose to mislead the opposite party on the part of the person to be estopped. In the case of the Leather Manufacturers' Bank vs. Morgan, 117 U. S., 108, the Supreme Court approvingly said:

"In Continental Bank vs. Bank of the Commonwealth, 50 N. Y., 575, it was held not to be always necessary to such an estoppel that there should be an intention upon the part of a person making a declaration, or doing an act to mislead the one who is induced to rely upon it. 'Indeed,' said FOLGER, J., 'it would limit the rule much within the reason of it if it were restricted to cases where there was an element of fraudulent purpose.' "

Many other cases are cited by counsel, pro and con, which it is not necessary to consider and review. The exact question we have under consideration seems to be met by the foregoing decisions, which are conclusive.

While it is true that the complainants' proceedings in the Patent Office were not had with any reference to the defendant, but had reference solely to their relations to the public, the defendant had, as one of the public, the same right to be influenced and governed by the complainants' conduct as though it had been the result of their representations to each other as individuals or corporations. The complainants' proceedings were a matter of public record. Their acts and conduct were of such notoriety that the defendant, by law, was bound to take notice of them, so far as they affected its legal rights under the complainants' patent.

But conceding that there is doubt as to whether the above decisions are conclusive of the controversy, the revocation which the complainants claim to have made of their dedication to the public was not made until March, 1893, nearly ten years after their voluntary limitation of the term of their patent, as hereinbefore stated. If they were in doubt as to the legality of their conduct in the proceedings in the Patent Office, they should have acted as soon as such mistake was suggested. They could not wait until the public had acted on their dedication, had acquired rights and equities, and then, after the Courts had declared their action unauthorized, proceed to revoke their grant.

Did the defendant, in good faith, act upon the complainants' limitation of the life of their patent, and was it induced so to act by the conduct of the complainants, and is it now in such relation to the complainants as estops them from denying that their conduct induced the defendant to make its investments and act as it has set forth in its motion now under consideration?

The circumstances under which the defendant began its enterprise of manufacturing electric incandescent lamps, the different stages in the progress of its development, and the reasons inducing it to increase its capital, are fully set forth in its motion, and as hereinbefore recited. Whatever may be the complainants' claim with reference to the defendant's statement of the circumstances under which it originally entered into this enterprise, it seems well established by the affidavits of the defendant's directors that its capital stock was increased, and its capacity for manufacturing incandescent lamps greatly enlarged by reason of its belief that the complainants' patent, by its own conduct, was limited so as to expire on the tenth of November, 1893.

This was a very important fact, and the claim that it largely influenced the defendant in its conduct is both reasonable and natural. For the reasons hereinbefore fully considered, it seems to me plain that the complainant is estopped from now claiming that its conduct did not induce such well defined belief as to the limitation of its patent on the defendant's part. Without deciding how far others not similarly situated had the right to rely upon such conduct on the part of the complainants, or without passing upon the question of how far the public generally acquired rights under the complainants' proceedings in the Patent Office, by which they limited the life of their patent, it is sufficient to find, under this motion, that the defendant, by reason of the circumstances particularly set forth in its motion, did rely in good faith upon the complainants' conduct, and had a right to be, and was, in fact, influenced thereby.

The application for a dissolution of the injunction is based upon evidence as to a fact which did not exist at the time the temporary injunction was allowed. At the time such application was made the complainants' patent had not then expired according to the limitation put upon it by its proceedings in the Patent Office. The rule is well settled that on such an application the complainants' rights to an injunction must be clearly established. While it is true that on a motion to dissolve, the burden of proof is on the defendant, yet the rule is equally well settled that evidence which would prevent the allowance of an injunction would be sufficient to dissolve it, and that an injunction will be dissolved on new evidence raising grave doubts as to the complainants' right to the temporary injunction in force. The rule is well expressed by Judge Nixon in the case of Carey *et al.* vs. Domestic Spring Bed Company *et al.*, 26 Fed. Rep., 138. In that case the complainants' patent, for the protection of which a temporary injunction was asked, had been sustained by three different Circuit Courts prior to the filing of the bill in Judge Nixon's district. Upon the strength of those prior adjudications, Judge Nixon ordered the injunction, "without an examination of the merits, or expressing anything upon the validity of the patent." But upon motion to dissolve, new affidavits were offered to show prior use. After an examination of these affidavits, Judge Nixon says:

"It does not appear that such testimony of prior discovery, knowledge and use of the invention was brought to the notice of either of the learned Judges who granted the injunction in the other cases. * * * I do not think that I should have seen my way clear to allow the preliminary injunctions in the present case if it had been presented on the original motion; and the rule is a good one that the evidence which would prevent the issuing of an injunction ought to be regarded as sufficient to dissolve one already granted."

For the reasons hereinbefore stated, if, on the application for the injunction now in force, the facts now relied upon in support of the motion to dissolve had been available as a defense, I would not have allowed the temporary injunction. The complainants' right to such an injunction, under such a defense, would have been so doubtful that it would not have been entitled to an injunction under the rules cited.

To continue the injunction now, in view of these doubts, would certainly be a great hardship upon the defendant. According to the affidavits now before the Court, the defendant is a solvent corporation. Under the Ohio law, the personal liability of the stockholders is an additional indemnity to which the complainants may look in case, upon a final hearing, its right to a permanent injunction should be established.

As the case is now presented on the motion to dissolve, the two parties must suffer loss. If the injunction is continued the defendant is wholly without remedy. It has shown that it was honestly misled by complainants' conduct, and, in good faith, made additional investments upon the belief so formed. The complainants cannot complain if, for this reason, the benefit of the doubts expressed are given to the defendant and the injunction is dissolved. If I am in error as to this conclusion, no great harm can result to the complainants, for if such error is established they can recover for the damages caused thereby, and their right to contest as to other infringers not able to show such meritorious claims to estoppel as defendant has established, can be asserted without prejudice from this decision.

STEPS IN THE EDISON-BERNARD LITIGATION.—PARTIAL INJUNCTION GRANTED.

In the suit of the Edison Electric Light Company against the E. G. Bernard Company, of Troy, N. Y., in the United States Circuit Court, the motion for preliminary injunction to restrain the defendants from erecting an electrical power and lighting plant at the Watervliet arsenal, has been denied by Judge Coxe as to the power plant, but the defendants are enjoined from using the feeder patent for lighting purposes until the determination of the suit. The text of the decision has been received as we go to press.

DECISION AGAINST A CITY PLANT AT HIAWATHA, KAN.

The decision of Judge Thompson on the electric light injunction case, wherein the city of Hiawatha undertook to put in an electric plant and compete with the private plant already there, was handed down on Jan. 20, and is against the city. The court holds that if the city could light the streets, it could also light the houses, which would be against franchise rights of the company.

LAMP LITIGATION IN PHILADELPHIA.

Argument was heard last week before Judge Acheson in the United States Circuit Court, Philadelphia, in the suit of the Edison Electric Light Company, to have the Manufacturers' Club, the Spreckels Sugar Refining Company and the Messrs. Crump, of the Colonnade Hotel, enjoined from using incandescent lamps alleged to contain infringements on the plaintiff's patents. A preliminary injunction was granted.

FEEDER AND MAIN PATENT LITIGATION.

Edison Electric Light Company *vs.* F. P. Little Electrical Construction and Supply Company, The Binghamton State Hospital, *et al.*

Edison Electric Light Company *vs.* E. G. Bernard Company, Isaac Arnold, Jr., *et al.*

United States Circuit Court, Northern District of New York.

Memorandum on Motions for Preliminary Injunctions.

Coxe, J.

My time is so completely occupied with other imperative matters that I cannot give to the consideration of these motions the examination which, in other circumstances, I would be glad to give them.

Regarding the action against the Little Construction Company and the Binghamton State Hospital, I think the contract should be considered in the light of the affidavits and explanations at the argument. To construe its language strictly in view of these subsequent statements would hardly be doing justice to the defendants. I am not sure, however, that I fully comprehend the details of the plant which the contractor proposes to install at Binghamton. So far as I am able to understand it I have considerable doubt whether the large conductor which is to be employed will infringe the patent in suit.

It is by no means clear that the contractor has adopted or will adopt the patentee's "particular way of forming such a conductor." It is difficult to comprehend the contractor's motive in using the very large feeder wires if the method in the patent is to be adopted. Though the Binghamton system is not the "Tree system," as the latter is described in the opinion in the New Jersey case, it would seem to be nearer the "Tree system" than the system of the patent. Surely there is a doubt.

When it is remembered that the speedy installation of this plant is necessary for the health and well-being of the unfortunate inmates of the institution I think the doubt should be resolved in favor of the defendants.

If the complainant deems a bond necessary for its protection it should be given. A bond in the sum of $5,000 is sufficient in the first instance. It can be increased should occasion arise.

As to the Watervliet Arsenal the case is different. It would seem that as to some, at least, of the consumption circuits, it is proposed to adopt the precise method of the patent. There can be no hardship to the United States in issuing an injunction, as the officers of the Government, by giving their approval to what, at the argument, seemed a perfectly fair and equitable arrangement between the complainant and the contracting defendant, can at any moment remove the only obstacle which prevents the speedy completion of the work. Having refused to grant this apparently reasonable consent they are not in a position to urge the inconvenience and injury to the Government as a reason for withholding the writ.

An injunction should issue, but it should restrain the defendants only so far as the electric lighting plant is concerned.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 9, 1894

Accumulators :—

Secondary Battery, F. K. Irving, New York, 512,473. Filed Sept. 13, 1893.

Claim 4 follows :

The gauze plate folded to form pockets, the porous cups within the pockets and the binding rods surrounding the gauze elements and porous cups to hold the elements in a group.

Electrode for Secondary Batteries, W. Morrison, Des Moines, Iowa, 512,514. Filed Apl. 25, 1892.

Consists of a plurality of bundles built up from a continuous ribbon of the requisite material and conducting rods connecting the bundles.

Alarms and Signals :—

American District Electric Signal Apparatus, C. E. Scribner, Chicago, Ill., 512,400. Filed Dec. 27, 1886.

Relates to apparatus in connection with district messenger service systems in which the call boxes in a certain district are electrically connected with the central station.

Fire Alarm Attachment, C. E. Egan, Chicago, Ill., 512,672. Filed May 27, 1893.

A push button normally used for ordinary signalling purposes but adapted to act as a thermostat in case of fire.

Conductors, Conduits and Insulators :—

Insulated Conductor, C. N. Waite, Newton, Mass, 512,417. Filed Feb. 20, 1893.

Relates to the insulation of lead gas conductors used in the manufacture of chlorine by the electrolysis of alkaline chlorides.

Distribution :—

Electrical Transformer or Converter, C. L. Coffin, Detroit, Mich., 512,603. Filed Dec. 11, 1891.

Claim :

In a transformer or converter a secondary formed of perforated metal.

Dynamos and Motors :—

Coil for Electromagnets, N. Tesla, New York, N. Y., 512,340. Filed July 7, 1893.

Claim 1 follows :—

A coil for electric apparatus the adjacent convolutions of which form parts of the circuit between which there exists a potential difference sufficient to secure in the coil a capacity capable of neutralizing its self-induction. See p. 87 this issue.

Spark Regulator for Dynamo Electric Machines, C. E. Scribner, Chicago, Ill., 512,397. Filed June 1, 1889.

Maintains the field of force of the short circuited coils practically constant while the field of force of the current producing coils is caused to vary automatically, responsively to variations in the resistance of the circuit.

Alternating Current Dynamo, J. J. Wood, Fort Wayne, Ind., 512,424. Filed June 23, 1893.

Relates chiefly to certain details of construction of alternating dynamos with stationary fields.

Connection between Separately Excited Dynamos and their Exciters, J. J. Wood, Fort Wayne, Ind., 512,425. Filed Oct. 17, 1893.

Employs a rigid connection between the movable bases of the dynamo and exciter so that the latter shall follow the movements of the former.

Device for Blowing out Sparks on Commutators of Dynamos, H. W. Hanahan, Winnsborougn, S. C., 512,612. Filed March 28, 1893.

Galvanic and Thermo-Electric Batteries :—

Depolarizer for Voltaic Cells, G. Hewitt, New York, 512,510. Filed April 3, 1893.

Consists of nitric acid, sulphuric acid and bichromate of sodium in the form of a dry powder.

Battery, W. M. Stine, Athens, Ohio, 512,567. Filed July 21, 1891.

Employs an alkaline electrolyte formed of a mixture of sodium hydrate, sodium zincate, sodium chloride, and sodium chlorate, the whole in aqueous solution.

Lamps and Appurtenances :—

Electric Incandescent Lamp, J. Peil and C. K. McFadden, Chicago, Ill., 512,320. Filed April 18, 1893.

Claim 1 follows :—

In electric incandescent lamps, the combination with a glass bulb of a metallic cap, a removable and insertible fusible metallic seal in the cap, and insulated inleading metallic wires inserted through the seal.

Lamps and Appurtenances :—

Duplex Arc Lamp, C. E. Scribner, Chicago, Ill., 512,401. Filed May 1, 1891.

Provides circuits and mechanism whereby two separate arc lamps connected in the same circuit may be caused to burn successively.

Socket for Incandescent Lamps, T. L. Pfarr, Jr., Pittsburgh, Pa., 512,448. Filed Feb. 13, 1893.

A socket and plug by means of which current may be taken to another point without disturbing the operation of the lamp or other device already attached to the socket.

Incandescent Lamp, A. C. Carey, Lake Pleasant, Mass., 512.461. Filed March 29, 1893.

Employs a bulb adapted to be fitted to ordinary sockets and to support a filament containing tube removable from it at pleasure.

Electric Arc Lamp, R. Niewerth, Berlin, Germany, 512,481. Filed March 22, 1893.

Employs a rotary shaft, a series of electrodes supported on the shaft, a commutator also supported on the shaft and a series of brushes bearing upon the commutator and connected with the source of electricity.

Electric Arc Lamp, R. Niewerth, Berlin, Germany, 512,482. Filed Oct. 24, 1893.

Claim 1 follows :

An electric arc lamp, composed of a series of electrodes arranged around a common axis and means for supplying the electrodes in pairs successively with electric currents in opposite direction, so as to impart alternately positive and negative polarities to the electrodes and form a continuous arc of uniform size.

Incandescent Electric Lamp, J. W. Turnbull, Pascagoula, Miss., 512,637. Filed May 2, 1893.

Claim 1 follows :

The combination with a bulb, of a separable tube, open at both ends, inserted therein and forming therewith a vacuum chamber.

Double Carbon Arc Lamp, C. E. Scribner, Chicago, Ill., 512,667. Filed April 16, 1892.

Metal Working :—

Furnace for Heating or Working Metals Electrically, C. L. Coffin, Detroit, Mich., 512,602. Filed Apl. 2, 1891.

Employs a refractory bed containing a coil of pipe the end of which opens through the bed, means for forcing air through the coil and mechanism for maintaining an arc on the bed over the end of the pipe.

Apparatus for Electrically Welding Metal, C. L. Coffin, Detroit, Mich, 512,604. Filed Mch. 9, 1883.

Employs means for maintaining two arcs, one on either side of the metal to be welded.

Metallurgical :—

Art of Producing Metallic Zinc, P. C. Choate, New York, 512,361. Filed Jan. 21, 1892.

Provides an electrolytic solution of zinc from which a commercially pure metallic zinc may be obtained by electrolysis.

Miscellaneous :—

Apparatus for Producing Ozone by Electricity, E. Andreoli, London, Eng., 512,265. Filed Aug. 25, 1892.

Electrolytic Apparatus, E. Andreoli, London, Eng., 512,266. Filed Feb. 20, 1893.

Employs supplementary cathodes of porous conducting diaphragms placed between the main cathode and the anode.

Stop Motion for Knitting Machines, G. J. Manderfield, Royersford, Pa., 512,310. Filed Mch. 21, 1893.

Electrically Propelled Vehicle, J. H. Rogers & W. Fracker, Washington, D. C., 512,327. Filed Jan. 31, 1893.

The application of a motor operated by storage battery to a light road wagon.

Time and Dating Stamp, W. S. Jewell, Indianapolis, Ind., and A. C. Stevens, Des Moines, Iowa, 512,378. Filed July 11, 1891.

Electric Valve Controller, C. E. Oagley, New York, 512,316. Filed Dec. 18, 1890.

An electric valve for regulating hydraulic elevators.

Electrolytic Diaphragm, T. Craney, Bay City, Mich., 512,505. Filed Sept. 26, 1892.

A tubular diaphragm consisting of an inverted U-shaped casing of non-porous material and containing a porous medium.

Railways and Appliances :—

Trolley Cut-Out, M. Hanford, Malden, Mass., 512,373. Filed Sept. 22, 1893.

The invention consists in making the trolley wire in independent sections electrically connected at the hangers and so supported therein that should a break occur the weight of the broken end will cause the end in the hanger to tilt upward out of connection with the line.

Closed Conduit Railway, C. J. Kintner, New York, 512,414. Filed June 22, 1893.

Employs normally disconnected sectional conductors and a series of removable pivoted switching boxes journaled in the sides of the conduit and mechanically actuated switching devices inclosed wholly in the boxes.

Electric Railway Current Collector, E. M. Roynton, West Newbury, Mass., 512,585. Filed Oct. 12, 1893.

Claim 1 follows :

In an electrically propelled bicycle car, the combination with the guide wheels of one or more current collectors guided and carried by the framework of said wheels.

Switches and Cut-Outs :—

Electric Cut-Out, A. P. Seymour, Syracuse, N. Y., 512,331. Filed Nov. 18, 1892.

Electric Switch, J. L. Hinds, Syracuse, N. Y., 512,614. Filed May 16, 1892.

Employs a pair of terminals attached to a base plate, a lever having contact faces to engage the terminals, and push buttons mounted on a lever.

Telegraphs :—

Printing Telegraph, E. A. Wirsching, 512,422. Filed May 12, 1893.

Relay, F. M. Locke, Victor, N. Y., 512,656. Filed June 19, 1891.

Employs a magnetic connection between the armature and the cores of the magnet to reduce the effect of residual magnetism in the latter.

Telephones and Apparatus :—

Electro-Magnet, F. R. McBerty, Downer's Grove, Ill., 512,386. Filed May 16, 1893.

Has for its object to produce a magnet responsive to alternating but not to continuous currents. Especially adapted to telephone annunciators.

Apparatus for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 512,398. Filed Apl. 26, 1893.

Provides means for automatically switching the operator's telephone into and out of circuit with the plug circuit by means of which connection is established between lines.

Apparatus for Telephone Switchboards, C. E. Scribner, Chicago, Ill., 512,399. Filed Apl. 26, 1893

Provides means for resetting the annunciators electrically by a momentary current controlled by a key actuated in the performance of some act involved in the establishment of connection between lines.

Telephone Call Recorder, W. B. Thomson, Chicago, Ill., 512,413. Filed June 28, 1893.

Provides means whereby the number of the calling telephone may be recorded at the called telephone when the call is not answered.

Time Indicator Attachment for Telephones, C. Stever, San Jose, Cal., 512,454. Filed Mch. 24, 1893.

A GRAND TRUNK ELECTRIC RAILWAY.

IT has been proposed by a Mr. Corliss, of Haverhill, Mass., to run a double-track electric street railway from Haverhill to Nashua, N. H., running through Ayer village and Hudson. The distance is only about 20 miles in a reasonably straight line. The wide expanse of territory to be traveled over would necessitate a double track to accomodate the large population.

The system contemplates a power station at the Salem, N. H., depot. The electric cars will branch from it to Lowell and Lawrence, also coming from Nashua, Manchester, Chester and Derry. All these will pass and repass on the same double track from Salem depot, a central point, through Ayer village, thence through North Broadway to Haverhill city proper. Red electrics will also connect at Haverhill from Plaistow and Hampstead with electrics to points on the seashore—Salem, Beverly, Gloucester, Rockport, Plum Island, Newburyport and other places.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

JUDGE RICKS'S DECISION—HOW THEY LOOKED WHEN THEY HEARD THE NEWS.

WHAT THEY SAID: "WELL! WELL!! WELL!!!"

IS THE GENERAL ELECTRIC DOOMED?

The *New York World*, of Jan. 29, publishes the following extraordinary special dispatch:—

> LYNN, Mass., Jan. 28—Prof. Elihu Thomson, the inventor and main reliance of the Thomson-Houston Company in defending its patents, has declared war upon the General Electric Company, and, according to his associates, is to be one of a number of the original Thomson-Houston people to try to secure the big West Lynn plant for a new corporation which will manufacture under his patents.
>
> It is understood that Prof. Thomson declares he never sold his arc lamp to the General Electric people, and he claims to have another incandescent lamp which will drive the one now manufactured by the General Electric out of the market.
>
> Soon after the consolidation the Thomson-Houston people claimed the Edison people had misrepresented their assets, and they brought suits in this State, under various pretexts, to discover whether it were possible to divorce the original Thomson-Houston from the General Electric. They did not find a legal way to do this, and the determination to start anew followed. John Pevear, a local capitalist, is mentioned as the probable President of the new corporation.
>
> The original contract made with the General Electric 'made it obligatory on Prof. Thomson to offer all of his inventions to that company first, but it appears that the company has not kept its part of the contract and that the Professor prefers cash to promises. This is why he has not prepared to follow the caravan to Schenectady, and this is the reason why, he says, he "will make them sick."
>
> The factories of the General Electric here will close February 1 for an inventory, but it is not believed that they will reopen again as announced. Eighteen months ago there were nearly 4,000 persons employed at the West Lynn plant, but now only 500.
>
> The Thomson programme is war to the knife on the old concern and no alliance, friendly or otherwise, with any other corporation.

MR. H. F. PARSHALL, one of the leading designers of dynamos and motors, has, it is stated, resigned from the General Electric Co.

MR. SAMUEL INSULL and his brother Mr. Martin Insull have just returned from a brief trip to England.

MICA COMMUTATOR SEGMENT.

This is the age of realism in more than one direction. The trolley gives us real rapid transit until modified by real laws limiting its speed to less than that of horse cars; people with real capital manufacture real non-infringing lamps that are stopped by real injunctions sometimes with real stays attached, and so on *ad infinitum*. And now Messrs. Eugene Munsell & Co. of 214 Water street, New York, are sending to their friends real mica segments for commutators and rheostats, neatly pasted upon the pages of neat little pamphlets. This is wise. It is hard to draw a picture of a Munsell mica segment; well-nigh impossible, in fact, for not only is it perfectly transparent but its edges are so smoothly cut that one is not at all certain where they occur. We have tried to remove ours from the page and after splitting off upwards of nineteen or more perfect sheets have become tired and stopped; but there seem to be still plenty left.

The pamphlet also shows sizes and shapes of segments for various purposes always kept in stock, and is accompanied by a long price-list of mica sheets ranging in standard sizes from 1½ x 3 to 8 x 10 inches. There are also special larger sizes.

NEW RAILWAY EQUIPMENT FOR PHILADELPHIA.

THE GENERAL ELECTRIC COMPANY have secured a large slice of the street railway car equipment contracts awarded during the last ten days in Philadelphia. Of 250 contracted for by the People's Traction Company, 125 equipments with the G. E. 800 motors and type K controllers were purchased from the General Electric Company, while the remaining 125 were allotted to the Sperry Company, of Cleveland.

Of 80 equipments required by the Electric Traction Company, of Philadelphia, 70 will be furnished by the General Electric Company. The People's Traction Company had already contracted for three of the great 1,500 K. W. General Electric generators.

The General Electric Company have also secured contracts during the past week, covering:—20 car equipments for the Union R. R. Co., of New York; 25 car equipments for the Steinway R. R., of Long Island; 10 car equipments for the St. Louis Railway Co.; one 700 h. p. generator for the Steinway R. R. of Long Island; eight m. p. 300 K. W. generator for Cincinnati, Ohio.

A VALUABLE CANADIAN INDUSTRIAL LIST.

WE have received a copy of a Canadian work entitled "The Shipping Manufacturers' List" (560 pages), by M. J. Henry, Toronto. The work should be of great service to merchants and manufacturers of Canada who are buyers of Canadian goods. A supplement (48 pages) containing the names, business and post office address of all manufacturers in the above work is printed in pamphlet form, alphabetically arranged, for the use of those in the United States and other countries who wish to address Canadian manufacturers. A * indicates steam power. The price of both books is $3; or the supplement $1, mailed to any address on receipt of price. Address M. J. Henry, publisher, P. O. Box 384, Toronto, Ont. The book is a handsome quarto, and its get up is a credit to Canadian typography.

GRAPHITE LITERATURE.

ABOUT a year ago the Joseph Dixon Crucible Co., of Jersey City, issued a pamphlet on lubricating graphite. It embodied an elaborate scientific opinion by Prof. R. H. Thurston on the value of graphite as a lubricant, and much interesting information on the subject from practical men. The pamphlet has had a large circulation, and the company has been enabled to obtain from well-known men a vast amount of additional knowledge on the uses of graphite. Another pamphlet, twice the size of the former, will be issued early in February, and a copy will be sent free of charge to all interested in the subject of friction and lubrication.

THE ELECTRIC APPLIANCE COMPANY were well represented at the Milwaukee Convention of the North Western Electric Light Association by the President, Willard W. Low and by Mr. Frank McMaster, with samples of their leading specialties. The "Finest of the Wheat," a special circular for the convention setting forth the merits of the Standard push switch, Washington arc lamp, Packard "Mogul" lamp and Packard transformer, attracted considerable attention and was favorably received by the many station managers present.

MR. F. H. BADGER, JR., well known in Canada from his long connection with the Royal Electric Co., of Montreal, has resigned his position of superintendent of its lighting department and accepted that of general manager of the Montmorency Electric Power Co. of Quebec. This company is largely increasing the capacity of its system by the erection of a new station equipped entirely with new and improved machinery.

OPENING OF THE SAN FRANCISCO MIDWINTER FAIR.

Mr. W. F. C. Hasson, the electrical engineer-in-chief of the Midwinter Fair, of whose plant descriptions have already appeared in the Engineer telegraphs us as follows:—"Steam plant was set in working condition Thursday, January 25. The electrical illumination of the grounds is working successfully this evening of the official opening day."

SWAN LAMP MFG. CO.

The annual meeting of the stockholders of the Swan Lamp Mfg. Company was held at its offices in Cleveland, Ohio, on January 16th. The following officers and directors were elected :—S. H. Hamill, president and general manager; B. F. Niles, vice-president and treasurer; S. E. Cox, secretary and superintendent; B. P. Roberts, electrician. Directors: W. H. Lawrence, B. F. Niles, L. H. Rogers, Webb C. Hayes, S. H. Hamill.

WESTERN NOTES.

B. E. Sunny, general Western manager of the General Electric Co. left Chicago for a trip to Boston on Monday, the 22d inst.

The Chicago and Central Union Telephone Companies held their annual meeting in Chicago last week. The old boards of directors were re-elected and dividends of 12 and 5 per cent. respectively were declared on the capital stocks of the two companies.

Louisville, Ky.—The telephone exchange at Louisville, Ky., was entirely destroyed by fire on the 20th inst. The switchboard, with its 3,000 connections is a total loss. The estimated loss, including that on rentals, is $80,000. The insurance on fixtures was $25,000.

Chicago Electric Club.—The effects of the Chicago Electric Club were sold at auction on Wednesday evening last. The club some time ago decided to wind up its affairs and this is about the last of its official acts. Only a small amount was realized from the club's effects.

An electric light plant is to be erected by the Lake Street Elevated Railroad Company at 1137 West Lake street, Chicago. It will be one story and basement, 40x60 feet, and will cost $7,000. The current generated will be used for lighting the stations and their platforms and stairways.

Messrs. Sargent & Lundy have removed from their old offices on the 14th floor of the Monadnock Block to more convenient and commodious quarters on the ground floor of the same building where they expect to carry in stock a full line of Crocker-Wheeler motors for which they are the Western agents.

The Movable Sidewalk described in The Electrical Engineer some time ago is attracting considerable attention in Chicago, as a possible solution of the problem of affording rapid transit in the down town sections of the city, particularly as a loop circuit connecting the various terminals of elevated and cable lines. Prominent citizens are identified with the movement.

Chicago Telegraphers.—The annual meeting of the Chicago Telegraphers' Aid Society was held last week at Lincoln Hall, Chicago. The report showed disbursements of $1,747 in sick benefits during 1893. The treasury contains a balance of $1,000. The membership is 300. C. W. Potter was elected president; C. L. Clevenberg, vice-president; W. H. Mills, secretary, and W. E. Griffiths, treasurer for the ensuing year.

For Western Electric.—The United States Court of Appeals composed of Judges Jenkins, Grosscup and Seaman, which met in Chicago last week overruled the motion for a rehearing in the case of the Western Electric Co. against the Sperry Electric Company for infringement of patents on electric lamp improvements. The court held that there was no ground for a rehearing. The case was decided some time ago in favor of the plantiff.

Wilbur F. Davidson, of Port Huron, Mich., who is general agent for the state of Michigan for the General Electric Co. has just been given a verdict in a Chicago court for $43,000 damages against the Illinois Central Railroad Co. On Feb. 27, 1893, while Mr. Davidson was alighting from a train at 53d street, at a point where the railroad tracks were then being elevated, he was caught between trains and received injuries about the back and hips from which he has never fully recovered.

The Chicago Edison Company, of which Samuel Insull is president, has issued a call for a special meeting of the stockholders on Feb. 21, for the purpose of voting on a proposition to increase the capital stock from $3,000,000 to 5,000,000. The funds to be derived from the new issue will be used for various improvements and extensions, particularly on the West side. The directors expect to use $1,200,000 in this way during 1894. One of the directors is authority for the statement that the plans contemplate the entire abandonment of the Adams street station and the fitting up of the Harrison street station in such a manner as to greatly reduce the cost of production.

A TRIUMPH FOR "CHICAGO ELECTRIC" WIRE.

The Goodyear Hard Rubber Co., 9 Mercer street, New York, sole agents for the Chicago Electric Wire feel considerably elated over the fact that they have been awarded the contract by the United States Government for 75 miles of submarine cable, now being made and intended for the very exacting work of Torpedo service. Mr. P. Campbell, of the company informs us that the tests were of the most thorough nature and that the cable has withstood the ordeal at every stage. As the government has hitherto, for some prejudice or other, deemed it necessary to go abroad for its cable, Mr. Campbell looks upon this contract as a great triumph and as another proof that American cable is now fully equal, if not superior, to any made in Europe. The samples shown us by him are certainly very fine.

THE BRISTOL CO.

The Bristols' Mfg. Co., of Waterbury, Conn., announce the incorporation of their company under the name of The Bristol Co. This company manufactures recording instruments for various purposes. Their recording voltmeter is meeting with considerable favor among lighting and railway stations. One concern in St. Louis has eleven of the instruments in use.

NEW YORK NOTES.

Mr. W. H. McKinlock, of the Metropolitan Electric Co., Chicago, favored the office of The Electrical Engineer with a long call last week, when the electrical situation was pretty thoroughly discussed. He takes a very hopeful view of the outlook, does not believe in a hasty recovery but in a very steady and marked return to normal conditions of activity. The Metropolitan incandescent lamp is a pronounced success, and is enjoying a large demand.

Commodore P. Vedder, "a graduate of the towpath," well-known in legal practice in this state, and also as State Assessor, U. S. Register in Bankruptcy, Assessor of Internal Revenue, etc., and more lately as President of the New York and New Jersey Ice Lines, has been chosen general manager of the Cataract General Electric Company—a position of great importance and responsibility in which his intimate acquaintance with canal matters will be of the greatest value.

The Newton Electric Co., Taylor Building, 39 Cortlandt St., have purchased the business recently conduced by the Imperial Electric Co. and will manufacture and sell all the specialties which they controlled in connection with a general line of lighting appliances. The Newton company have increased their capital stock to $15,000 cash and Mr. W. J. Newton, their general manager, tells us they intend doing a much more extensive business this year. They are certainly getting ready for a large trade with a number of excellent specialties and novelties, especially as applied to incandescent lighting.

NEW ENGLAND NOTES.

Perkins Electric Lamp Company.—It is expected that this company may soon again be heard from, as it is understood that on the strength of the recent decision by Judge Ricks in Cleveland, they will at once apply for a dissolution of the injunction under which they were placed about a year ago.

The Pettingell Andrews Company of Boston, have just secured the exclusive agency for New England, of the famous P. and B. paint, manufactured by the Standard Paint Company, of New York. They report now that business is getting quite brisk, and they are having large sales in their other specialties, especially in tubing of the Interior Conduit Company of New York, and the well known standard specialties of Okonite wire.

The Beacon Vacuum Pump & Electrical Company of Boston, are busily engaged in sending out large quantities of their perfected lamp which is giving now entire satisfaction to the consumer. The new Beacon lamp possesses, as every one knows, many new features, and many difficulties were encountered in giving the public a lamp which could be depended upon, as new principles were involved in its construction. The experimental stage is entirely past, and the Beacon lamp, as now manufactured, gives excellent satisfaction. It is a marked improvement on their previous manufactures. The Beacon Company are so well satisfied with their new lamp, and find it so easy and economical to manufacture, that they will not at present, even since hearing Judge Ricks' decision in Cleveland, apply for a dissolution of the injunction served on them some months ago. They claim that the lamp is just as good as, if not better, than the old Beacon, is cheaper to manufacture, and that they can consequently give their customers, just as satisfactory an article at a very much reduced figure.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. FEBRUARY 7, 1894. No. 301.

THE TELEPHONE PATENT SITUATION.—IV.

WHERE a transmitter is employed that uses an induction coil, the claims of the Watson patent would seem to cover the simplest switching devices in which springs are used, whether automatic or not; where no induction coil is used, however, there is no primary circuit as distinguished from a secondary circuit and it would seem unnecessary to infringe these claims. There are numerous minor support patents, all of which are subordinate to the patents already mentioned and which are hardly worth referring to in this article. There are, however, a few interesting devices which can scarcely be held to be subordinate to these patents, and which will be of interest to inventors. One of these is the patent of Sigmund Bergmann, of October 31, 1882, No. 266,750, the claims of which are as follows:

1. The combination, with a telephone-receiver (or transmitter) and a supporting device thereof, of a switch and contacts, and a permanent magnet and armature moving such switch, and brought into action by the attaching of such instrument to such supporting device, substantially as set forth.

2. In a telephone-switch, the combination, with a polarized switch-lever, of the movable instrument having an iron ring carried thereby, substantially as and for the purpose set forth.

3. In a telephone-switch, the combination, with a movable instrument provided with an armature, of a pivoted horseshoe-magnet provided with contacts and acting as the switch-lever, substantially as set forth.

The device covered by the claims above is certainly not subsidiary to the patents hereinbefore mentioned as the moving force is magnetism and not gravity or the pressure of the hand. Neither could the patent of Samuel H. Bartlett of October 7, 1884, No. 306,050, be said to infringe any of the patents thus far alluded to in this article. The following are the 1st and 2d claims of the Bartlett patent:

1. An electrical conducting-cord having a switch device contained therein, substantially as described.

2. An electrical conducting-cord composed of two or more wires bound together, having a switch device contained within the body of the cord, substantially as described.

Mr. Ezra T. Gilliland in his patent No. 237,971 of February 22, 1881, shows an ingenious, if not very practicable, method of solving the telephone support problem. His claims are brief and the first well describes his invention, viz.:

In combination with a telephone, two posts or parts formed with cavities in their adjacent faces, and a ball which is inserted in said cavities, said cavities having a formation, substantially as described, by which said ball is caused to establish an electrical connection between said parts when the telephone is in one position, and to break said connection when it is in other positions, substantially as and for the purposes set forth.

Another interesting device is that covered by the patent of the joint inventors, W. H. Eckert, J. A. Seely and E. A. Eckert. There are only two claims to this patent, which is dated October 24, 1882, and is numbered 266,277. The 2d claim is as follows:

2. In a telephone circuit, the combination of a receiving telephone having keys upon its body with a separate transmitter and battery, arranged as described, whereby when the receiving telephone is grasped by the listener the keys can be operated to switch the receiving and transmitting telephones and battery into the line circuit.

Mr. S. Bergmann has also contributed another interesting and ingenious device to the collection of telephone support switches; the invention is covered by his patent of December 28, 1880, No. 235,988. The following are the claims in full:

1. The combination of a telephone-instrument, a support for said instrument when it is not in use, means which preclude the placing of the instrument on the support or its removal from the support without a movement of the support by the hand, and a switch which is operated simultaneously with the movement of said support to connect the instrument with or disconnect it from the electric circuit or line with which it is used, substantially as specified.

2. The combination of a telephone-instrument, a bolt adapted to be operated by hand and serving to support the instrument when it is not in use, means which preclude the placing of the instrument on or the removal of the instrument from the bolt without a movement of said bolt, and a switch operated by the movement of the bolt to connect the instrument with or disconnect it from the electric line or circuit with which it is used, substantially as specified.

3. The combination, with a bolt upon which a telephone-instrument may be hung and a switch operated by the movement of the bolt, and serving to connect the instrument with and disconnect it from an electric circuit or line with which it is used, of a pair of jaws or devices extending transversely to the bolt, substantially as and for the purpose specified.

4. The combination, with a bolt upon which a telephone-instrument may be hung and a switch operated by the movement of the bolt, and serving to connect the instrument with and disconnect it from an electric circuit or line with which it is used, of a pair of jaws or devices extending transversely to the bolt, and a cross bar or bars extending between said jaws or devices, substantially as and for the purpose specified.

5. The combination, with a bolt and a switch operated by the movement of the bolt to connect a telephone-instrument with or disconnect it from an electric circuit or line with which it is used, of an eye on the telephone-instrument, whereby it may be attached to and supported on the bolt by slipping the bolt through said eye, substantially as and for the purpose specified.

Another patent of Messrs. W. H. Eckert, J. A. Seely and E. A. Eckert, dated March 3, 1885, No. 313,409, is also interesting. The first claim which fairly describes the invention, is as follows:

1. The combination with a telephone-station apparatus, of a switch, consisting of a movable plate carried by the receiver and supported in front of the ear-piece thereof, and contacts and connections arranged so that said switch is shifted to connect in the telephone apparatus by application of said receiver to the ear, substantially as described.

This article in our series might be continued at great length to deal fully with the details of the minor telephone support patents; it will probably be sufficient, however, after having taken up the principal ones, to direct attention to a few patents not already mentioned, in order that those interested in the matter may see how thoroughly the subject of automatic telephone supports has been covered. Among these remaining support patents are the following: Jos. R. H. Hinton, Feb. 21, 1888, No. 378,250. Wm. C. Turnbull, Sept. 7, 1886, No. 348,936. Wm. C. Turnbull, March 30, 1886, No. 338,889. T. A. Watson, Oct. 10, 1882, No. 265,897. John C. Francis, Jan. 3, 1893, No. 488,993. Chas. W. Lewis, Oct. 24, 1882, No. 266,374. Milo G. Kellogg, June 28, 1881, No. 243,575. Chas. W. Lewis, Oct. 24, 1882, No. 266,295. Henry W. Cozzens, June 6, 1882, No. 258,894. Charles E. Scribner, Oct. 25, 1881, No. 248,671. John D. Lyle, Dec. 23, 1884, No. 309,791. T. A. Watson, Nov. 5, 1878, No. 209,592. Henry W. Comstock. June 9, 1885, No. 319,789.

THE COPPER-ZINC ACCUMULATOR.—III.

BY

Dr Paul Schoop

It may be well now, to try to explain why the Desmazures accumulator has not as yet met with that success, which a reliable traction cell is bound to do. In describing the Lalande cell, the probable chemical reactions during its discharge have been set forth. The whole difference between the Lalande cell and a fully charged Desmazures accumulator is, that the latter contains not *oxide* of copper, but *suboxide* of copper. A Lalande cell might, partially discharged, represent exactly the same galvanic combination as the fully charged Desmazures cell. But the main trouble in the accumulator rests with the *charging*; it will be necessary therefore at this point to look into the reactions which are involved in the charging process in order to understand the difficulties connected with it.

When the Desmazures cell is fully discharged, there is pure, porous copper on one side and a pure steel sheet on the other side, while the electrolyte contains water, caustic potash, zincate of potash (zinc-oxide, dissolved in caustic potash, forms a chemical compound, called zincate of potash), and mercurate of potash (hydro-oxide of mercury dissolved in potash).

If a current is now passed through the cell in the right direction making the copper side the anode and the steel side the cathode, perhaps the following reactions might occur: Caustic potash is decomposed, leaving on the steel sheet potassium and at the copper side a higher oxidized compound, perhaps the hydrate of peroxyde of potassium, corresponding to the better known compound, called peroxide of hydrogen. But neither of these compounds can exist under the present conditions; the potassium at once precipitates zinc out of the zincate of potash, this zinc being deposited on the steel sheet (cathode), the potassium combining with the rest of the broken zincate of potash molecule and forming caustic potash. The peroxyde of potassium, too is decomposed into ordinary caustic potash and oxygen, the oxygen being at once absorbed by the porous copper and suboxyde of copper is formed. Now the peroxyde of potash, at low temperatures, is a pretty stable compound providing the caustic potash solution be concentrated, and does not decompose very easily. Besides, it may be that the electrolysis of caustic potash, at low temperature forms more complex compounds of potassium, oxygen and hydrogen,—compounds, which contain oxygen in a different state of activity. Whatever the case may be, the porous copper does not absorb so readily the oxygen of these compounds. Instead of the simple and desirable product of suboxide of copper, other compounds of copper are simultaneously formed, compounds containing more oxygen, for instance, oxide of copper, hydrates of oxide of copper and perhaps salts of cupric acid.

It has not been made known what the blue-colored soluble compound really is, which is formed when the copper accumulator is charged with the usual density of current at low temperatures.

It will be seen from the above, that the charging of the copper accumulators depends a good deal upon the temperature at which the process takes place. In this respect, the old lead accumulator is less troublesome, since it may be charged at any temperature reigning throughout the year without giving rise to trouble. Temperature has also some influence on the lead accumulator, but it does not interfere with the practical service very much.

It is a matter of fact, that the charging process at the copper anode with the copper accumulator has to be carefully watched and several conditions must be kept within certain limits; if not, the whole service of the accumulator might be disturbed.

But not only does the copper side of the battery give rise to drawbacks, but the cathode or zinc side also. Electro-metallurgists know, that the deposition of zinc in a coherent, firm and metallic form is not at all an easy task. First of all, the surface, on which the zinc is to deposit, must be pure and metallic; the least superficial oxidation hinders the adherence of the zinc deposit. The mercury, added by Desmazures to the electrolyte, has for its purpose to amalgamate the steel sheet and thus to facilitate the adherence of the zinc deposit. It may be further stated, that the nature of the deposited zinc depends upon the temperature of the electrolyte, the percentage of zinc the electrolyte contains, the density of current, the circulation of the electrolyte and other conditions. It will be seen again, that the charging process of the zinc side is not so simple by far, as it is with the old lead cell. To sum up: The management of the copper accumulator is much more difficult at present, than that of the lead accumulator, so far as the Desmazures accumulator is concerned.

The Phillips-Entz Accumulator.—This type of copper-zinc battery is the latest perfection of the alkaline accumulator It has been described before by the inventors and need be only briefly cited here. The improvement relates mainly to the anode or copper electrode. As is known and more fully described in the patents granted by the U. S. Patent Office, the copper electrode consists of a copper cable, made in the following way: Round a central wire is loosely woven fine copper wire and the space between this loose wire netting is filled with a paste, made of a mixture of finely ground oxide of copper and sulphur. Afterwards the whole is exposed to nearly red heat and then a braiding of asbestos applied to the pasted cable. The sulphur is burnt out by the oxygen of the oxide of copper and pure copper in a highly porous state remains. The copper cable is then wound into the form of a mat, provided with insulators and a connection piece and is now ready for use in the cell. In the finished element, the containing vessel forms part of the cathode and the steel sheets, forming the cathode are put in electrical connection with each other by means of the sheet steel vessel.

Some data, obtained by the writer during an investigation of some accumulators of the Phillips-Entz accumulators (the investigation was made in August, September and October, 1891) may be of some interest.

Weight of anode (copper electrode)........	2	lbs.	18	ounces.
" " cathode (two steel sheets)......	1	"	1	"
" " vessel, including connections..	1	"	10	"
" " electrolyte..............,.......	8	"	8	"

Weight of complete cell, about 9 lbs.

The capacity of such a cell was, at a discharge rate of 20 amperes, about 80 ampere-hours. The voltage was 0.77 volt on an average during discharge; or the capacity in watt hours was 61, at a current giving 15.4 watts output. The charging was effected with a current of 10 amperes during 10 hours; the voltage was 0 90 volt at the start and 1.05 at the end of the charge. Both the charge and the discharge were performed at a temperature of about 130° F, these directions having been given by the inventors. It had been found that the capacity of the cells varied according to the rate of the discharging current and that the resistance and therefore the efficiency varied considerably according to the temperature of the accumulator.

To avoid the absorption of carbonic acid from the air, a layer of paraffine oil was applied on the surface of the liquid. The cells were neatly manufactured and yielded more electric energy than any of the known types of lead-accumulators. The main question and one, the importance of which ranks above all others,—reliability of the service of the cell,—is that of durability. In this respect, an experience of only some weeks or months is hardly sufficient and this point is perhaps only known to the manufacturers of this type of battery. One would imagine, however, that, if the carbonic acid of the air or dust cannot enter into the cell, and if the proper attention is applied in charging, at least the same durability, or even a greater, could be obtained than with the lead-accumulator. The handling of the Phillips-Entz cell is no doubt a little more complicated than that of a lead accumulator. Everything considered it must be said that the practical work of those batteries, installed for traction purposes by the inventors, alone can decide and prove the superiority of this type.

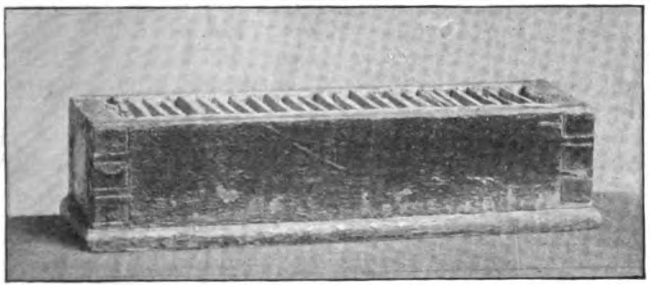
THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—V.

BY

Mary A. Henry

We have come to a very important day in the history of the telegraph.

We have seen in the last chapter how the magnet grew under Henry's hands until it could lift fifty times its own weight, and how, when it had seemed to come to the limit of its power, Henry had conceived another method of winding the wire on the iron, so as to form an instrument of still greater strength. Did Henry neglect his first child for this its new, strong brother? Not so, and it was well, for it had its secret, which on this day it revealed. When it failed to respond to his demands beyond a certain length of wire, the question of the relative capacity of different lengths of wire to transmit the electrical current immediately seized upon his mind, and it was to test this that he undertook a series of experiments on this memorable day.



PROF. HENRY'S "COMPOUND" BATTERY.

It was the year 1829, and July was just ending or August just begun. As Henry entered the Academy building he directed his steps to a long room or hall—used for the public ceremonies of the institution—where the experiments were to be made; and where, he says —"1060 feet, a little more than one-fifth of a mile of copper wire of the kind called bell-wire, .045 of an inch in diameter were stretched several times across the large room."[1] We may not attempt to give in detail all the experiments, although only a few of them were recorded. We confine our attention to one of them and the steps which led to it; the one in which Henry made the combination which constitutes the telegraph; the only combination possible for the telegraph, now as then. Not by accident was this combination made; it was the necessary result of the process of research. What was the combination? A magnet, a battery, and that long wire around the room. *The magnet*:—it was not the stronger one of many coils, but the first, of one long coil, with its secret which there and then it revealed, and this was the secret:—that it possessed the subtle power of being excited by electricity from a distant source. *The battery*:—it was not one of a single pair of plates, such as we have seen Henry using, but a compound battery of many plates, shown in Fig. 1. It too had its secret, which it too then revealed, viz.:—that a current of electricity from it could act upon a magnet through a wire of any length, as easily as if attached directly to the magnet, provided it had this particular magnet to act upon. But we are anticipating. Let us see how Henry made this combination.

We have seen that hitherto his attention had been confined to the lifting power of his magnets, and that his aim had been to produce the greatest magnetic effects with the smallest expense of galvanic power. We have seen him working constantly with a single pair of galvanic plates, and these very small. On this day he was to see how his magnets could act at a distance. The object of his experiments was to investigate—by means of different lengths of wire, and batteries of different strength—the resistance of the wire to the electric current. Besides single plates of various size, he had ready a compound battery of *twenty-five plates*, arranged in a trough, as we have said. The resistance of the wire to the electrical current! We recognize in it the old, old difficulty in the way of the telegraph. Henry about to investigate it, was in fact face to face with the recreant electricity, to demand of it why in all these years it had baffled the world by failing to act at a distance. His assistant in the experiments to be made was a young man of his own age Dr. Philip Ten Eyck, of Albany.

He began the experiments with the same small pair of plates we have seen serving him so well, two inches square. He used at first a galvanometer to tell whether the electric current could exert any effect, acting through a long wire stretched back and forth across the room.

"From the mean of several observations the deflection of its needle was 15 degrees." Then Henry substituted the magnet of a single coil. This magnet, so ready to respond hitherto to the action of these two plates—would it do so through this one-fifth of a mile of wire? "The magnetism was scarcely observable in the horse-shoe." Was the old world right; was the galvanic force unable to act through any great length of wire?

> "The small plates were removed" and larger tried, "a battery composed of a pair of zinc plates 4 inches by 7 inches, surrounded with copper was substituted. When this was attached immediately to the ends of the 8 feet of wire wound round the horse-shoe, the weight lifted was 4½ lbs: when the current was passed through the whole length of wire (1060 feet) it lifted half an ounce."

Again the result seemed to say that galvanic power could not overcome the resistance of a long wire.

Did Henry try still larger plates? Had he made them many times the size, the result would have been relatively the same. He abandoned the battery of a single pair of plates; the compound battery of many plates stood there in its trough, and then was made the experiment which gave the telegraph. Let us give it in Henry's own words.[2]

> "*Experiment* 7. The whole length of the wire was attached to a small trough on Mr. Cruikshank's plan, containing 25 double plates and presenting exactly the same extent of zinc surface to the action of the acid as the battery used in the last experiment. The weight lifted in this case was 8 oz.; when the intervening wire was removed and the trough attached directly to the ends of the wire surrounding the horse shoe it lifted only 7 oz. *From this experiment, it appears that the current from the galvanic trough is capable of producing greater magnetic effect on soft iron after traversing more than ⅕ of a mile of intervening wire, than when it passes only through the wire surrounding the magnet.* It is possible that the different states of the trough, with respect to dryness, may have exerted some influence on this remarkable result, but that the effect of a current from a trough, if not increased, is but slightly diminished in passing through a long wire, is certain. A number of other experiments would have been made to verify this had not our use of the room been limited, by its being required for public exercises.

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[1] *Silliman's Journal*, Jan., 1831—Vol. XIX.

[2] *Silliman's Journal*, Vol. XIX, or Writings of Joseph Henry, Vol. I., p. 41—Smithsonian Contributions.

> **"On a little consideration however, the above result does not appear so extraordinary as at first sight, since a current from a trough possesses more "projectile force," to use Prof. Hare's expression, and approximates somewhat in intensity to the electricity from the common machine. May it not also be a fact that the galvanic fluid, in order to produce the greatest magnetic effect, should move with a small velocity, and that in passing through one fifth of a mile, its velocity is so retarded as to produce a greater magnetic action: But be this as it may, the fact, that the magnetic action of a current from a trough is, at *least*, not sensibly diminished by passing through a long wire, is directly applicable to Mr. Barlow's project of forming an electro-magnetic telegraph; and it is also of material consequence in the construction of the galvanic coil. From these experiments, it is evident, that in forming the coil we may either use one very long wire or several shorter ones as the circumstance may require: in the first case our galvanic combinations must consist of a number of plates so as to give 'projectile force'; in the second, it must be formed of a single pair."**

How simple are the words which tell, as if it were some unimportant matter, that the circuit was at last formed in which electricity would not fail; but not only had Henry's magnet responded to that battery through all that length of wire more easily than when magnet and battery were in immediate contact; the closing words of the paragraph quoted show that Henry had fully recognized the cause of the phenomenon. He had made the great discovery of the law of relation between the "projectile force" in the battery and the resistance in the coil.

He knew the importance of what he had accomplished; he says:—

> **"This was the first discovery of the fact that a galvanic current could be transmitted to a great distance with so little diminution of force as to produce mechanical effects; and of the means by which the transmission could be accomplished. I saw that the electric telegraph was now practicable; and in publishing my experiments and their results, I stated that the fact just mentioned was applicable to Barlow's project of such a telegraph. I had not the paper of Barlow before me, and erred in attributing to him a project of a telegraph, as he only disproved, as he thought, the practicability of one. But the intention of the statement was to show that I had established the fact that a mechanical effect could be produced by the galvanic current at a great distance, operating upon a magnet or needle, and that the telegraph was therefore possible. In arriving at these results, and announcing their applicability to the telegraph, I had not in mind any particular form of telegraph, but referred only to the general fact that it was now demonstrated that a galvanic current could be transmitted to great distances with sufficient power to produce mechanical effects adequate to the desired object."**

So they were brought together for the first time that day,—the battery which could act at a distance and the magnet which could be acted upon at a distance. The magent was Henry's; he had endowed it with its subtle power. The battery was not his; but he had discovered its latent power and how to awaken this by calling in the aid of his own child.

In the telegraph of to-day the magnet used to receive the message is the same as the magnet used in the combination formed that day in Albany. The battery is essentially the same, but the one fifth of a mile of wire has stretched to many miles, even to the three thousand that lie between the shores of the ocean; and Henry's magnet answers as easily to the electric effects of the battery through all this distance as it did there in that room. The discovery made that day was to effect the world.

How do we know the date of these experiments? Henry published his account of them in *Silliman's Journal* of Jan. 1, 1831. He does not say positively, in that paper, whether they were made in 1829 or 1830, and why we place it in 1829, we will tell a little later. For the month we refer the reader to a casual remark of Henry which we have quoted. He says: "A number of other experiments would have been made to verify this had not our use of the room been limited by its being required for public exercises." These public exercises took place on the annual exhibition day of the academy; they consisted in speeches and other exercises by the pupils; and were attended by the parents of the boys and the friends of the institution. It was the great day of the year for the Academy. According to the records it was the 9th of August in this year, 1829. The three or four days preceding it were devoted to examinations of the pupils, also open to the public. In was on the 5th of August this year that Henry's classes were examined. As in the interest of the experiments Henry, as he indicates, would have retained the room as long as possible, we place the experiments in one of the first two or three days of the month of August or in one of the very last days of July.

The small trough battery used is now in the National Museum at Washington. It not only told Henry that day that electricity could act at a distance; it led him to another discovery. In the course of the experiments, the poles of the battery had been connected with a long wire. As Henry detatched one end of this, from wire to battery flashed a brilliant spark. This was a beautiful invitation to research in a new field. It was Henry's first intimation of the phenomenon of self-induction or the "extra current" as it is called. Henry says: "My experiments on the transmission of power to a distance were superseded by the investigation of a remarkable phenomenon, which I had observed in the course of these experiments, of the induction of a current of a long wire on itself, and of which I made first mention in a paper in *Silliman's Journal* in 1832, Vol. xxii." As soon as he had made a practical test of his discovery in regard to the telegraph he accepted the invitation of the spark, and so began investigations, which were at intervals continued in Albany and Princeton, until he was called to the charge of the Smithsonian Institution. That bright spark is of particular interest just now, since it is on account of the investigations it prompted that Henry's name has been given to the unit of inductance.

The evening of the eventful day had come, and Henry went home to receive that sympathy which from the constitution of his nature was especially essential to him in everything. "Sympathy is, with the man of genius especially (and in a measure with all men) an intellectual want as necessary as the coarsest elements of existence. I can bear testimony to the truth of this saying." These are Henry's words.

BI-METALLIC TELEPHONE CONDUCTORS.

BY

A. E. Kennelly

Concerning bi-metallic telephone wires, it appears to the writer that any proposition which asserts that a combination of two metals in a conductor is superior for telephonic purposes to a similar conductor of either metal alone,—seems to be entirely new, deserves to be considered with circumspection, and lays the burden of proof entirely upon experimental evidence.

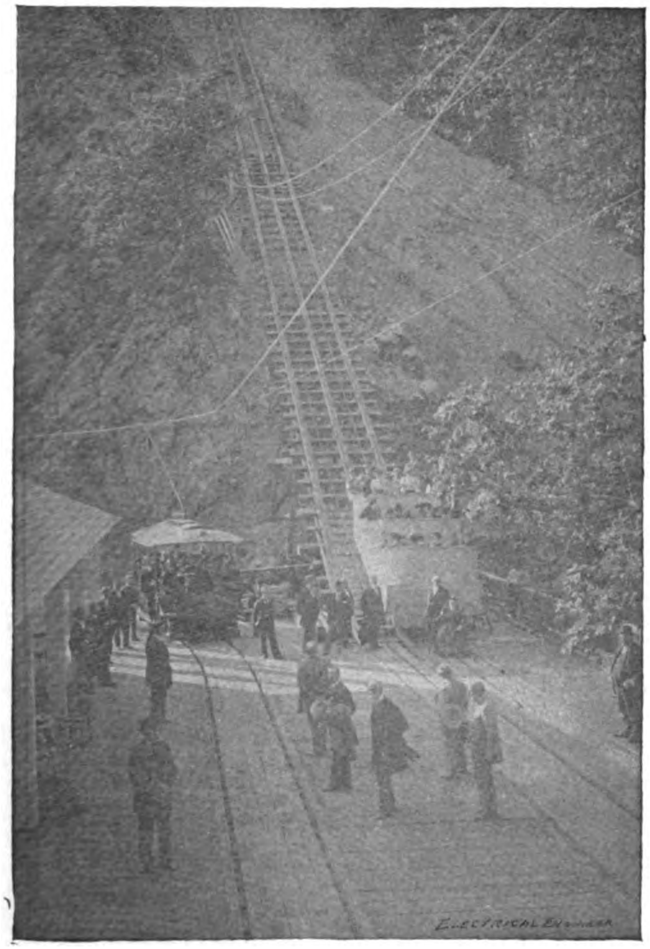
In the case of iron, however, it is orthodox to suppose that the inductance possessed by an iron wire is advantageous in long distance telephony within reasonable limits if the resistance of the conductor were at the same time capable of being sufficiently reduced. Also that when a definite adjustment between inductance, resistance, and capacity of the conductor has been attained, it is consistent with present recognized views to suppose that a comparatively low insulation can be permitted. In this connection lies the possibility for a superiority of a compound iron-copper wire over one wholly of copper or of iron; but even then the advantage, if due to these reasons, should attend definite relations of composition and disposition in the wires and not iron-copper wires indiscriminately.

MR. MAXIMILIAN MINTZ.

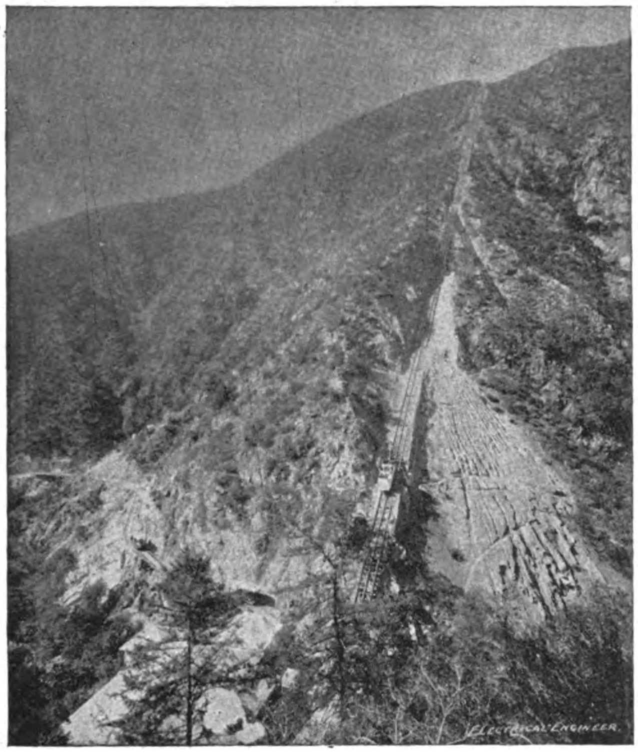
A CORRESPONDENT inquires for the address of Mr. Maximilian Mintz, representative of the Grob petroleum engine. Replies may be addressed to this office.

ELECTRIC TRANSPORTATION DEPARTMENT.

FROM STRAWBERRIES TO SNOW BY THE MOUNT LOWE ELECTRIC ROAD.

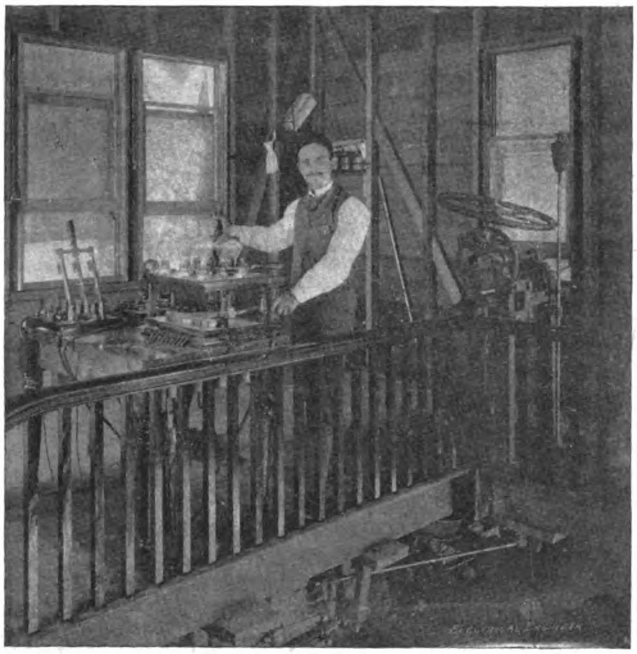


Foot of Great Cable Incline Operated by Electric Motor, Mt. Lowe Railway.



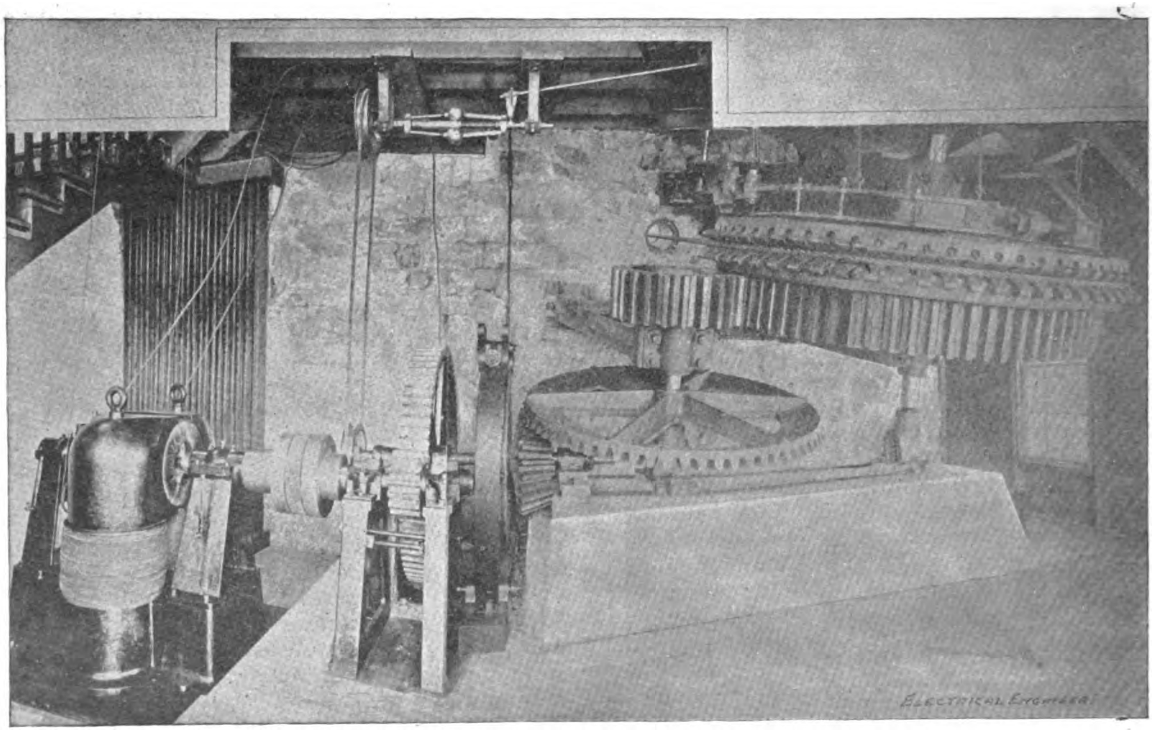
Junction of Trolley System and Cable Road.

THE electrical engineer who is fortunate enough this Spring to visit the California Midwinter Fair is likely to enhance the pleasure of his westward journey by a trip into Southern California. Should he do this, as many another tourist has already done before him, he will discover that the attractions of the Los Angeles region have been greatly added to in a manner that will appeal to him not less from the technical than from the æsthetic standpoint. Some nine miles from Los Angeles, and nestling at the feet of the Sierra Madre range, is the young and beautiful city of Pasadena, which has gathered itself into the lap of the hoary mountain very much as the fair Shunnamite cherished old King David. Of course the city is ornate with orange groves and flower gardens; that we all expect of even the smallest and least ambitious South California community; but one is hardly prepared for such a wealth of it or for so many evidences of substantial prosperity in the more utilitarian forms of brick and mortar, paved streets, opera house blocks and the latest styles in dry goods. Back of all and above all tower the dark slopes of the mountains crested with snow at this season of the year, and the greatest charm of Pasadena is that through the energy of a leading citizen, Prof. T. S. C. Lowe, and with the help of electricity, the summits of the range have been made easily accessible. From Mount Lowe, an altitude of 6,000 feet, or even from Echo Mountain, 3,500 feet high, we command a view of extreme beauty, with snow capped mountains for a background; deep green valleys right and left—the San Gabriel, the San Fernando and others; and far away, across thirty miles of poppy field, calla lily beds, and fruit orchards, the Pacific Ocean. If it were night, we could see the distant rows of white arcs in the streets of Los Angeles, and the flash of the light house on the island of Santa Catalina, 60 miles away. Prof. Lowe, in a most ingenious and original manner has built a combined electric and cable road, opening up to travel this region of airy enchantment. Switzerland has lately seen something of the kind attempted in the electric road which runs in sight of the Jungfrau to the new Lauterbrunnen hotel from the top of the cable road, out of the valley; but Prof. Lowe starts from the Pasadena Valley with an electric road operated by gas engines; then operates a section of steep cable road by electric motor energized from the same power plant; and at the end of that has another electric road. The features of such a piece of engineering are, as we have already intimated, worthy of notice, and it is equally deserving of mention in such a journal as this that Prof. Lowe, distinguished for his ballooning exploits during the Civil War and for the gas system he invented and introduced, was the first to propose and assist in carrying out the combined operation of gas and electric lighting plants now so common but once so bitterly resisted. It need not surprise us that such a man, familiar with the enormous development of mountain travel and mountain hotels in the Swiss Alps



Regulating Apparatus for Cable Incline, Mt. Lowe Railway.

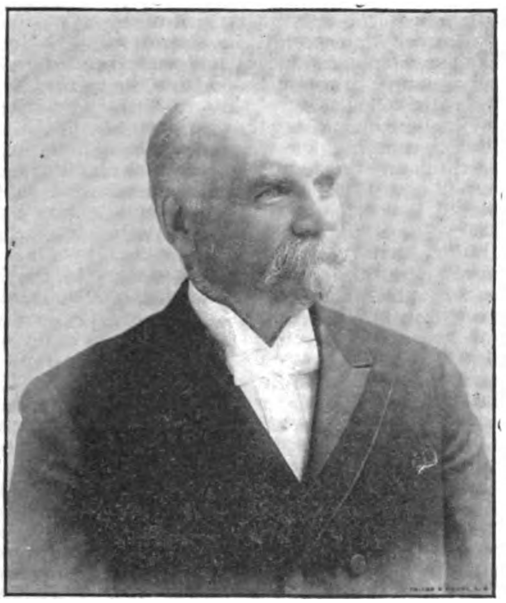
should have spent a large fortune in developing successfully the same means of recreation for Americans in the Pasadena Alps of Southern California, where tropical resources of pleasure abound that are not available in the playground of Northern Europe.



Electric Motor and Cable Operating Apparatus, Mt. Lowe Railway.

The ascent from the valleys is easy. Pasadena itself is about 800 feet above sea level, and Altadena Junction, where the Los Angeles Terminal Railroad delivers its passengers to the Mount Lowe trolley road, is about 1,000 feet high. Thence the trolley line runs by easy grades, nowhere exceeding 7½ per cent, to the Rubio Pavilion nearly 3 miles away, at an altitude of about 2,200 feet. This trolley section is well built, with bracket suspension of the trolley wire, and the track construction is excellent, as it need be in view of the large amount of curve of short radius. There are no fewer than eleven solid timber bridges on the stretch from Altadena to Rubio. Part of the road here had to be cut through solid granite by men who dangled in mid-air from ropes while they drilled and blasted. The little power house at Altadena is novel and interesting. It comprises two Otto gas engines of 60 h. p. each, capable of working up to 140 h. p. together. These drive an Edison generator of corresponding capacity, and a duplicate plant is held in reserve. Gas for fuel is made from gasoline, the carburetter and storage tank being situated near by. It is proposed, however, to utilize water power for the work by means of Pelton wheels installed at Rubio Pavilion, at the foot of the Great Cable Incline, and the water pipes for this system are already laid and final arrangements nearly completed. Current is not only furnished from Altadena to the trolley road direct but is also delivered to a Keith motor of 75 h. p. which drives the mechanism of the cable road; so that we have the unique instance of electricity running a trolley road and a cable road at one and the same time from the same plant.

The trolley road ends at Hotel Rubio, which stands in Rubio Amphitheatre, a beautiful and romantic spot graced with no fewer than eleven waterfalls the power of some of which is already utilized in lighting the Great Cable Incline and the two hotels built for the accomodation of patrons of the road. Here starts the Great Cable Incline, about 3,000 feet long, rising about 1,300 feet, and unrolling in its ascent a magnificent panorama of mountain, valley and sub-tropic vegetation. This Incline is double track, the inner rail serving as one side of either of the tracks, and the cars passing each other on a four rail turn-out about half way up. There are two cars, which are permanently attached to an endless wire cable 1½ inches in diameter. As one car descends the other goes up. The cars have rounded fronts, and have the seats arranged in three tiers of open "opera box" compartments, so that everybody has a clear and uninterrupted view. The car makes a trip in eight minutes, and will carry nominally 36 passengers, although 60 New Yorkers, trained in bad habits on the Elevated Road, have been known to squeeze in at once. The Incline is most substantially built, being practically terraced in the mountain side. There is some open work, however, and at one point the cars cross a trestle 200 feet long, one end of which is 100 feet higher than the other. Two of our illustrations show the modus operandi of running the cable. It will have been noted that the cars are balanced against each other, so that the call for extra lifting power is not great. The motor operates the train of gearing and the cable wheel, a feature of which is its sensitive automatic arrangement (of the Hallidie clip pulley type) for gripping the cable upon any strain above the normal, which thus prevents the cars from traveling beyond a predetermined speed. This is a quite necessary point of precaution when we remember that the average grade of the road is 59 per cent. or 11 per cent. steeper than the steepest portion of the Mt. Pilatus road in Switzerland. The clip pulley is set horizontally, and the whole mechanism is firmly anchored in solid granite. Upstairs, above the motor room, is the room in which the attendant operates the Incline, having all the control apparatus at his hand, and being in communication with the power house, etc., by means of the telephone.



PROF. T. S. C. LOWE.

At the summit of the Great Cable Incline we reach Echo Mountain House, 3,500 feet above sea level. This altitude with its lovely scenery would satisfy most people, but Prof. Lowe is pushing on to the summit of Mount Lowe, 6,000 feet high, and from the upper end of the Great Cable Incline proposes to run another trolley road connecting the Echo Mountain with an observatory, hotel, etc., at the summit of the noble peak named after him. Prof. Lowe has proposed that if a public or private subscription of $100,000 be made, in the purchase of stocks or bonds of the road, he will himself furnish the rest, for the extension of the road, and will also equip the observatory with a 37½ inch reflector, a 16 inch refractor, a 12 inch refractor and two 8 inch refractors, making a splendid outfit for astronomical work at a point where the conditions are peculiarly favorable for star study. This subscription would not need to be a donation (as was the case with the Lick Observatory), but being in the securities of the road, is considered by all competent financiers, who are familiar with its working, as a first-class investment, while at the same time furthering a worthy scientific project for the benefit of the world. We are enabled to state to our readers that if any individual will purchase this amount of securities, one of the noble peaks of the Sierra Madre range will be named after him, thus carrying his name down through all ages—a memorial more lasting and far more honorable than marble column or ostentatious tomb. It must be the wish of all who, like the present writer, know Prof. Lowe, that he may be no less successful than was Mr. James Lick in enlisting public support for such a praiseworthy scheme. Electricians will also be interested to learn that Prof. Lowe intends setting up a fine search light at the peak of Echo Mountain and that he is already in correspondence with American and European makers on the subject.

Before closing this article it should be added that there are a great many features of novelty and interest about the road beyond those already spoken of. At Rubio Pavilion, for example, the electric cars have their terminus in the hotel attic, and it might be said with truth that the roof of the hotel was built first. The means of entrance are akin to those patronized by Santa Claus, and one descends by means of the chimney—or elevator. Another curious feature is that Echo Mountain House is on one side of the mountain and its kitchen on the other, the connection being a tunnel lighted by incandescent lamps. Prof. Lowe certainly deserves congratulation on this original scheme for getting the cuisine out of range. Electric lights are also used with novel and beautiful effect in Rubio Cañon and the Thalehaha Falls; and the proprietors of Eastern mountain resorts could in more than one respect take a leaf out of Prof. Lowe's book.

We are indebted to Prof. G. Wharton James, F.R.A.S. (an accomplished lecturer, associated with Prof. Lowe in this enterprise) for much of the information contained in this article and for a fine set of photographs of the road, hotels, mountains, etc., of this wonderland of the Sierra Madre range.

ELECTRIC RAILWAY FIGURES IN ST. LOUIS.

SOME interesting figures were given out regarding the operation of the electric and cable roads of St. Louis. The National Railway Co., a Chicago corporation, capitalized at $2,200,000, controls five of the St. Louis roads, as follows: Cass Ave. and Fair Grounds (including the Northern Central and Union railways), electric, 35 miles and 70 motor cars; Citizens', 18 miles cable and 3 horse, and 172 cars in all; and the St. Louis R.R. Co.'s line operating 14⅜ miles of cable and having an equipment of 240 cars. At the annual meeting of this company held in Chicago it was announced that the net earnings for the year were $199,947 or 9.088 per cent. against 10 per cent. earned in 1892. The gross receipts of the five roads were $1,416,817, a decrease of 1.4 per cent. Operating expenses were 60.12 per cent. of gross receipts. The number of trips in 1893 was 877,302, a decrease of 16,988. The car mileage was 11,844,031, and the passengers carried 28,313,504—decreases, respectively, of 103.326 and 385,321. The gross receipts of cable lines were $1,035,455 while the gross receipts of horse and electric lines amounted to $381,372. Cable receipts decreased $50,987 while horse and electric car receipts increased $30,258. Comparing operating expenses it appears that the cable line expense was 59.4 per cent. of the income while horse and electric expense was 64 per cent. The cable mileage was 9,368,758 and of horse and electric lines 2,475,273, The cost of operating the cable per car mile was 7.32 cents or, including interest, 9.34 cents; while the corresponding figures for horse and electric lines were 11.09 and 13 11 cents. The new construction of the year which has cost $1,201,356 included 32.37 miles of new track, 33.2 miles of overhead electric construction, 70 motor cars and remodeling 131 old trailers, engines, power plant, etc. D. G. Hamilton, of Chicago, is president of the company.

PROF. BARRETT AND THE CONDUIT.

PROF. JOHN P. BARRETT, city electrician of Chicago, has declared that, according to his judgment, the Love underground trolley system, as now running in Washington, affords "a complete solution of the question of trolley electric street railroads."

MISCELLANEOUS.

THE THEORY AND DESIGN OF THE CLOSED COIL CONSTANT CURRENT DYNAMO.—III.—(*Concluded.*)

BY PROF. HENRY S. CARHART.

In the second method the overlap of the brushes must be inversely as the induction in a coil under the brush in different parts of the field, for the presence of the pole of the armature at any point reduces the induction. This point is a complicated one and needs further experimental study. But in the third class of machines the overlap of the brush is constant and the field is not weakened by cutting out coils on small load. Neither are the pole faces cut away to produce uniform induction. Attention is given to the thickness of the pole pieces so as to avoid unnecessary crowding of the lines of force toward the central portions. It is also desirable to avoid thinning the polar horns lest they become saturated.

The author then spoke of the old Sperry machines with internal pole pieces, and gave the results of some investigations made by him upon this type and also upon the old Gramme machine, from which he arrived at the conclusion that for practically sparkless commutation it is not necessary that the induction *near*, but *under* the brush shall be a constant. The effective means by which, with constant current, the brushes can be set in any plane round the commutator cylinder is the reactive effect of the armature. This fact is brought out quite clearly by plotting the integrated potential differences between the upper or positive brush and the third movable one as ordinates to a horizontal line.

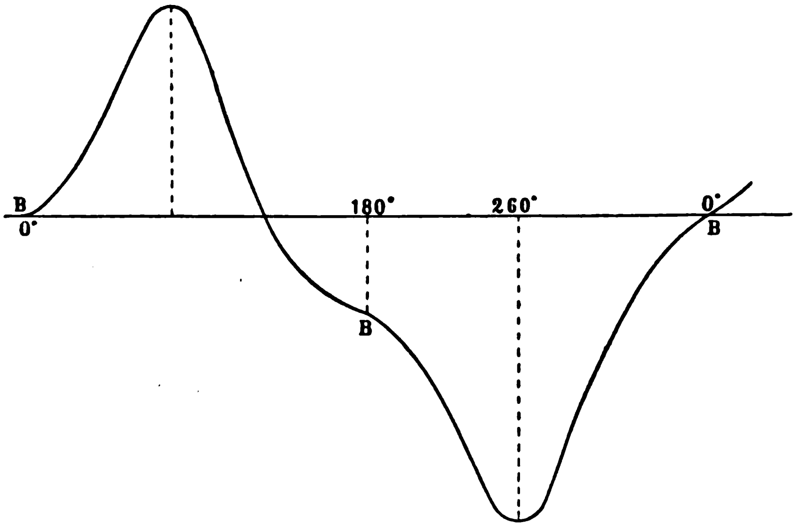


FIG. 2.

The data are the same as were employed to plot the first curve in Fig. 1.[1] If Fig. 2 is examined a decided flattening in the curve will be found at 180 degrees, the position of the negative brush. The same flattening may be seen at 0 degrees. All curves, plotted with data obtained at different loads, show the same diminution or stay of the inductive process near the poles of the armature. The armature at these points paralyzes the field. As the poles of the armature move round they sweep away the lines of force of the field, and only enough remain to produce an E. M. F. competent to offset the E. M. F. of self-induction and, in addition, cause the newly directed current to grow to its normal value as the coil passes out from under the brush.

This reactive power of the armature may be utilized to effect approximate regulation for constant current without brush-shifting. But for this purpose the load cannot be a maximum. The poles of the armature must be far enough forward to produce increase of magnetic leakage.

The conditions requisite for sparkless commutation of a constant current machine are quite clearly defined. The self-induction of the short-circuited coils must nearly balance the field in all positions of the brushes. The author then quoted Mr. Esson[2] and Prof. Ryan[3] as saying that the brushes must be kept under the pole faces in order not to enter the weakened fields between the pole corners, and stated that he did not consider this condition absolutely essential, since at maximum E. M. F. the brushes may be moved through a considerable angle without appreciable change in sparking. He dwelt upon this subject at considerable length and supported his statement by data from machines in actual operation.

In conclusion the author said: The design of closed-coil Gramme rings for high potential arc lighting has thus far been limited to the two-pole type of field-magnet. This involves the maintenance of higher speed than engineers find desirable. The conditions of present practice and the requirements for the immediate future demand a new departure in this class of dynamo design. All indications point toward a multipolar machine of about 50 kilo-watts capacity and slow speed. The armature will contain a liberal amount of iron, much larger than would be found desirable for constant potential machines. Such a dynamo is already in demand, and it will find an immediate field for the lighting of large cities.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—VIII.

BY PROF. GEORGE FORBES.

(*Discussion.*)

Mr. Alexander Siemens said it was only right to the Commission who asked for the tenders that he should put the matter from a different point of view from that represented by Mr. Ferranti. He had not the conditions upon which the tenders were given. He (Mr. Siemens) had the pleasure at the time of speaking to the President of the Commission, who explained to him that the conditions were to be, that the different competitors were to send in detailed designs, and if successful, superintend the construction of the machinery in America for a commission of 2½ per cent. or 5 per cent., he forgot which. Under those conditions they competed, but did not send detailed designs, and as a matter of course, were excluded from the prizes. But he was perfectly certain that nobody who read the conditions under which they tendered could say that it was not from the beginning the intention to construct the whole of the machinery in America. He did not think any question ought to arise about being able to send a current of 20,000 volts through underground cables. He, for one, would be perfectly ready to supply cables that would carry 20,000 volts. Such cables were in daily use at the Frankfort Exhibition, having been supplied by his firm for connecting the transformers in the machinery hall to those in the Main annex; the normal working pressure was 20,000 volts, the cables having previously been tested to 40,000 volts. Another point which had been insisted upon was that it was quite out of the question to think that a continuous current could serve for such a transmission. Well he was not so sure about that. Their own project for the Niagara transmission was for continuous current, using machines and motors in series. He was not sure that the Cataract Construction Company would not be converted to the continuous current before they had done.

Mr. S. Evershed said one speaker had spoken of the effect when large solid conductors were used; but Prof. Forbes did not say he was going to use large solid conductors, and he (Mr. Evershed) did not doubt that he would not do so. He showed in his diagram of the subway something which might be taken to be laminated strip conductors, so that the skin effect, elaborately discussed by Lord Kelvin, would not have any prejudicial effect. But there was one effect which would come in, and it was of vastly more importance, and that was the induction between the conductors, whether solid or laminated. It was easy to work out what the back electromotive force of induction would be for any pair of conductors run at any given distance apart, and he had worked out a few cases, taking the conductors to be 6 in. apart, or 12 in. or 3 ft. He also took the density at 333 amperes per square inch, which he understood the author proposed to use. He found that there was one great argument for using a low frequency as possible, namely, the enormous inductive drop in the lines if run at the 100 periods of Mr. Mordey. If they had mains of 3 sq. in. in section, as Prof. Forbes would have, and placed those mains 6 in. apart, if they ran at 100 periods they would have an inductive E. M. F. of 880 volts per mile. Running at 25 periods this was reduced to 192 volts, while the resistance drop was 27 volts. On that ground alone Prof. Forbes appeared to him to have an unanswerable argument in favor of low frequency in that particular case. The only other point he desired to refer to was the question of coupling in parallel. He wanted, if possible, to get Prof. Forbes to tell them distinctly what were the uses of an artificial load in coupling machines in parallel.

Mr. Crompton said there had been an important omission in the discussion. The question which was of real interest to them was, What would be the cost of power to the users in Buffalo or in the more distant towns? How would it compete with the cost of power produced in those towns? That was the point that would interest him most. He should think many engineers like himself had had such schemes on a smaller scale brought before them, and in the large proportion of cases they were reluctantly obliged to abandon them because the interest on the cost of the plant was so great as to overwhelm the advantages of

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1. See The Electrical Engineer, Jan. 24.
2. London *Electrician*, March 31. 1890.
3. Proceedings of the Am. Inst. Elec. Engrs., Vol. VIII, p. 465.

using water power. He had been forestalled in many of the remarks he would have made by Mr. Ferranti. The barefaced attempt to pick the brains of the world and then to utilize the information gained for the benefit of the American manufacturers was a thing to be admired. He was sorry to say that similar attempts were often made in England; he spoke feelingly. There were many who had spent their blood and treasure in the perfecting of the mechanical details and the other details of electrical machinery, and who could not get any reward for their labors simply because no system of patent laws could cover every little detail of design. The regular modern habit was for the last comer to pick the brains of the world, so they must not blame the Americans, who were only doing on a large scale what had been done so often before on a small one. With regard to the culvert he would not like to be in that culvert when 20,000 volts were going on. If an arc started at one end of that culvert it would go right up to the other end, the whole eighteen miles, in a very short time. Prof. Forbes was going to use porcelain insulators, and he would ask him if he had made experiments to know what the insulating power of porcelain was. What was good enough for electric telegraphs was not good enough for underground work, and failures had been made by those who without sufficient trial had adopted the material used for aerial insulators for underground work. They had made great improvements, and had now got a material that carried 200 volts satisfactorily; whether they would ever get a material which would carry 20,000 volts was beyond him at present. Oil insulators were supposed to be a great remedy, but he thought there were many there who would agree with him after a long trial that they were entirely useless. He did not think continuous currents had been condemned on sufficient evidence. It was useless for people to get up in that room and say there were no difficulties in the matter of "parallelizing" alternators. Grave difficulties did exist, and although Prof. Forbes might minimize them, and probably would, by his low frequency he would find he had not then got over the great problems that would arise. He did not agree with Mr. Ferranti that 40 periods were good enough to produce good electric lighting. He had seen many of Ganz's stations at 42, and the arc lighting was disgraceful.

Mr. Weeks asked Prof. Forbes whether his circuits were equally divided on either side, with the lead on one side and the return on the other. Prof. **Forbes** declined to answer this question.

Mr. Mavor said it would be interesting if Prof. Forbes would describe the method proposed for ventilating and drying the tunnel. This was a matter of the greatest importance, as constant atmospheric conditions in such a subway were most difficult to maintain. It was notable that the most severe criticism of the scheme for carrying high-tension currents along bare conductors in a culvert came from the principal exponent of the similar method of conducting low-tension currents. The author has said in his Paper that Mr. Tesla has clearly demonstrated the rapid deterioration of solid insulations with currents of high frequency, but many of these effects are also present with currents of low frequency at an equally high voltage.

Major-Gen. **Webber** said they ought all to feel the greatest sympathy with Prof. Forbes in connection with this Paper from one point of view. He had brought before them a Paper referring to work not yet carried out, and in criticizing the account he had been good enough to favor them with they should remember that it was inevitable that modifications would have to be made in carrying out that work.

Mr. Kapp gave an abstract of a communication from Mr. C. E. L. Brown. Mr. Brown advocated a higher frequency than Prof. Forbes, and with regard to running in parallel said he had been unable to detect any difference between low frequencies such as 15 and up to 100. It was astonishing that even at the present day so much was still said of the difficulty of running alternators, single or multiphase, in parallel. He had run machines of very different types in parallel under the most different conditions, and had never found the slightest difficulty; indeed, he had come to the conclusion that the coupling of alternators in parallel was as easy as, if not easier than, that of direct machines. To adopt the two-phase system using four wires seemed to him a good arrangement, and judging from his own experience none but good results could be obtained. It certainly seemed remarkable, considering the number of designs sent in, many of which were extremely good, that Prof. Forbes should have decided upon about the worst arrangement possible for his machine. He could not imagine a more inconvenient arrangement than the magnetic wheel revolving outside the armature, so that it was impossible to get at the machine while in motion, whilst losing entirely the ventilating effect of the revolving wheel for the cooling down of the armature.

FUNNY LEGISLATION.

A member of the New York Legislature has introduced a bill requiring the insulation of all electric wires used for street railroad purposes. By last reports, he was still at liberty.

ECONOMY IN THE USE OF TRANSFORMERS.[1]

BY P. J. McFADDEN.

A transformer is nothing more than a dynamo without moving parts and is therefore no exception to the rule that it works best when loaded up to its rated capacity. In selecting a transformer for a given customer, the central station superintendent will too often install one capable of supplying the total number of lights for which the house is wired. In some cases this cannot be avoided, but in houses wired, say, for 40 to 50 lights it will seldom be necessary to put up a transformer any larger than a 30 lighter, and right here I would say that a transformer of a whole size smaller can often be used if the superintendent would take the trouble to consider the case of the particular customer in question. The neighborhood, the size of his family and their habits relative to the probability of entertainments involving the burning of nearly all the lamps in the house, would all with a moment's consideration, determine sufficiently closely what the maximum load would be.

But is it always necessary to install a transformer for every individual customer? Are not some of your stores or even in some cases your residences, so bunched that one transformer could be made to do for several; and if so would you not, if necessary, go to a little trouble with your secondary wiring to accomplish this? Even the bunching of, say, three moderately large transformers to serve four or five consumers where one or at most two are likely to have a large load at one time and where this comes so seldom as to make it expensive to put up for each of them a transformer capable of taking that load, while a step in the right direction, is seldom good practice for if the primary fuse of one should blow them out not only does the secondary of that transformer (which is now dead, as far as its capacity to give out current is concerned) become a load upon the other two, but also the load of lamps it formerly carried must now be borne by the others. When this is the case the fuses of the other two will be likely to blow and the whole arrangement disabled.

More than one case has recently come to my notice, showing how in practice the substitution of one large transformer for several smaller ones has worked to the saving in first cost to the station, and, as we know from the principle of the transformer, in the economy of operation as well.

Aside from the advantages of regulation and efficiency which are far reaching in that their effect is operating continually, there are other and quite as palpable ones that especially recommend this system. Perhaps first of all comes the saving in the first cost. This plan not only preserves to you this advantage in first cost of large transformers but also admits of your using a very much lower capacity than the aggregate of the lamps wired up. There is a greater saving in the cost of installation and in the cost of repairs. Further than this the danger from lighting in the primaries is reduced at least in proportion to the number of transformers replaced.

I have spoken until now of the use of large transformers with secondaries connected on the ordinary two wire system using, if desired and the distances are not great, 52 volt lamps; otherwise 110 volts; but why stop here? The very reason why you adopted the alternating system was on account of the saving in copper in the mains and feeders, and you did this by sending a small current to a great distance at a high voltage, knowing that it is only amperage that demands a large cross section of copper. Now why not apply this principle to the secondary wiring as well, using as high a voltage as is permissable in practice. Manifestly this can be accomplished by running the secondary wiring on the 3 wire system having a difference of potential of 220 volts between the outside wires, and using 110 volt lamps. Here again we introduce a feature that, added to those above enumerated as being present in the use of large transformers, makes the system of 3-wire secondary wiring from transformers the most efficient that modern practice is capable of. The loss in the secondary wiring is here cut down to minimum, as the current is only one fourth of what it would be with an equal number of lamps of 52 volts and for the same percentage of loss, the actual drop in volts can be doubled. As a consequence the wire for a 220 volt circuit would need to be but $\frac{5}{64}$ of that for a 50 volt circuit.

Ordinary transformers can of course be connected in pairs with their 100 volt secondaries in series and run out on 3-wire, but a still greater saving is secured in using a transformer whose secondaries are so brought out that a 3-wire service is obtained directly from the one transformer.

Opportunities for the employment of the step-up and step-down transformer plan are rare in stations in this section and I have purposely confined my remarks to the employment of large transformers on the 2-wire system, or better yet two transformers with secondaries connected in 3-wire, or still better, and best of all, one large 3-wire transformer, as applications of these can be made in the plants of each one who is using alternate current.

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[1] Abstract of a paper read before the Northwestern Electrical Association, January 17, 1894.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies, - - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* The Electrical Engineer. *Communications for the attention of the editors should be addressed,* Editor of The Electrical Engineer, 203 *Broadway, New York City.*

Vol. XVII. NEW YORK, FEBRUARY 7, 1894. No. 301.

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THE SPEED OF ELECTRIC CARS.

THE comments on electric car accidents which come under one's eyes almost daily in the popular press are not calculated to raise the spirits of the managers of street railway corporations, while the damages which are declared against the roads by juries in numerous legal actions must eventually force them to adopt some means for their own protection, independent of the demands of the public. The spirited discussion which a short time since occupied the columns of The Electrical Engineer served to bring out a number of weak points, both in the electrical and in the mechanical equipment of the car, not to speak of troubles due to the personal characteristics of the motorman himself. Most stress was and is laid on the inadequacy of the methods of braking usually employed. A closer study of the situation, however, seems to show that there is still another factor involved in the safe handling of electric cars which has not yet had that attention bestowed upon it that its importance unquestionably demands—and that is, some means for enabling the motorman to know at a glance the speed at which his car is running. The large reserve powers with which the modern electric cars are very properly equipped in order to take care of heavy loads and stiff grades, place it within the power of the motorman to run at high speeds on level stretches, and recent investigations instituted by several municipalities have emphasized this point. Thus in Brooklyn, N. Y., Prof. Geo. W. Plympton of the city Electrical Subway Commission has just filed a report made at the request of Mayor Schieren which showed that the ordinance speed of 10 miles an hour was frequently exceeded, one case being recorded in which the car ran at no lessa speed than [illegible] e r hour. In St. Louis, where a speed of 15 miles an hour is permitted in some of the wider streets of the newer sections, a speed of 30 miles per hour is said to be regularly attained. These records could without doubt be largely duplicated on closer investigation, but they will suffice to account for many of the "accidents" which are now laid at the door of the trolley car. It would be folly to suppose that any system of braking, however powerful, could be applied to prevent accidents in city thoroughfares with cars running at the speeds above shown to be common; and if they could be applied to prevent accidents *outside* of the car, some means of insuring the safety of those *inside* the car would have to be devised next. City authorities may pass ordinances regulating car speeds, without end, but it is asking too much of the motorman to calculate or even to guess at the speed of his car, in addition to his other exacting duties. What is wanted is a simple and reliable speed indicator, which will enable the motorman to tell by a glance how fast he is running. Such an indicator might be of either the visual or the audible type, or both combined, and should be arranged to give warning as soon as the maximum permissible speed is exceeded. The slow horse car, and the cable car limited to a fixed maximum speed, evidently have never required such an indicator; but that it has become a necessary adjunct for electric cars is obvious. We venture to say that its introduction will be followed by a reduction of the number of "trolley accidents," and that the cost will be but a bagatelle compared with the reduction in the amounts now paid for damages. We commend to inventors the designing of an electric car speed indicator of this class.

PATENT LITIGATION.—THE SUPREME COURT ON DIVISIONAL APPLICATIONS.

We print in other columns of this issue a late decision of the Supreme Court, which involves certain considerations as to patents issued upon divisional applications, the results of which are likely to be scarcely less important and far reaching than were those of the celebrated decision of the same tribunal a few years since relating to reissued patents. Briefly, the doctrine now laid down by the Court, as we understand it, is that only one patent can be taken for a single concrete invention, or for any part of such invention; and consequently, that when more than one patent has been issued purporting to cover different parts of the same subject-matter, all except the one bearing the lowest serial number are void. Especially is it held by the Court to be inadmissible to distribute the subject-matter of an invention between two patents, distinguishable from each other only by the different functions ascribed to a common mechanical structure.

The conclusions which have now been announced by the Supreme Court, while they will probably entail hardship upon many deserving patentees, are in our opinion, intended, by a single well-aimed blow, effectually to discourage a vicious practice which has become of late years so wide-spread and general as to constitute a notorious abuse; a remark which, by the way, may be said to apply with especial force and pertinence in connection with patents for electrical inventions. We might cite more than one instance in which a verbose and rambling specification has been filed in the Patent Office, at an early stage in the development of some particular branch of the art, containing vague references to everything under the sun which the applicant could think of as having the remotest relation to the professed subject-matter of the application. This has been kept pending in the Office for years, in order that, whenever an applicant appeared with a bona-fide invention, which appeared likely to be valuable, a divisional application could be segregated from the original mass of matter, dressed into proper shape, and put into interference with that of the newcomer. Thus a long series of divisional patents could be obtained, keeping abreast of the progressive state of the art, which, by reason of their constructively early dates, could be made to control and subordinate the work of rival, and often far more meritorious, laborers in the same field. Again, an objectionable custom has grown up among a certain class of patent-attorneys, especially some of those employed by large corporations, of filing as great a number of separate applications upon each invention placed in their hands as their practiced skill in hair-splitting could enable them to formulate; and this often, it is to be feared, with no worthier motive than the unnecessary multiplication of their own fees.

We entertain no doubt that the ultimate effect of this decision will be wholesome and salutary. As to its immediate effect there is certainly abundant room for interesting speculation. One important patent may be mentioned, which would seem to be in imminent danger of being overthrown by the new doctrine:—the famous Berliner transmitter patent, which, as was pointed out in The Electrical Engineer of January 24, 1894, in reality covers the employment, as a transmitter, of a certain mechanical structure which, in its capacity as a receiver, was patented as long ago as November 2, 1880. There are also a very large number of patents on electric railway apparatus and devices, heretofore assumed by their owners to be controlling, and upon which a considerable number of pending suits have been based, which are founded upon divisional patents. Some of these, at least, must unquestionably be obnoxious to the doctrine now laid down by the Supreme Court. This authoritative exposition of the law certainly puts a new aspect upon some important phases of the apparently interminable litigation between the rival aspirants to supremacy in the electrical industries of the United States.

A LIE OUT OF WHOLE CLOTH.

It may be truly said that the electrical community was startled by the dispatch purporting to come from Lynn, published in the *New York World*, on Monday, Jan. 29, and alleging with much detail and particularity that Prof. Elihu Thomson, backed by Mr. Pevear, was about to leave the General Electric Co. and begin all over again in opposition. We characterized the dispatch as "extraordinary," yet its place of origin and its details were such as at first to make one think there might be some little truth in it, especially after the radical changes that the General Company has seen of late. Knowing that the subject is one of deep interest to many of our readers, we hastened to bring the dispatch to the notice of Prof. Thomson, whose written statement we now have to the effect that the story is wholly without foundation.

In other words, the dispatch was a lie made out of whole cloth, and probably intended to affect the stock market. It is a great pity that the liar did not confine himself to a mere flight of fancy. Prof. Thomson's distinguished services to the cause of electrical science and invention should have preserved him from any such attempts to use his great name as a catspaw for reckless and destructive speculation. It may fairly be said of him that his interest in discoveries or inventions has been measured by their importance in increasing knowledge or in meeting some demand, and we are not aware that their prospective cash value has ever added much to the "flush of victory." The practical commercial value of an idea is of course an element of ultimate success that all great inventors must consider, if only because it furnishes the means to push forward and accomplish still more. Each discovery or invention well worked out is a conquest for mankind, and not mere "prize money" drawn from Nature. These are Prof. Thomson's sentiments, and not the low, mean ones that the dispatch so shamefully attributes to him, by insinuation.

The Fan as a Foe to Frost.

The man who adds to the number of electrical applications is fittingly regarded as a benefactor, and in the category of such worthies should be included, we think, the genius who has utilized the electric fan for driving frost out of store windows. The experiment appears to have been tried at Lewiston, Me., with great success, and the business men are said to have put in several fans for such work, as they found they could get rid of the ice in less than ten minutes. The same cure should be effective for steamy windows. There are many places where fans run for coolness in summer could also be employed as an aid to ventilation in winter.

LEGAL NOTES.

A DECISION LIKELY TO AFFECT MANY ELECTRICAL PATENTS.—THE DANGER OF DIVIDING APPLICATIONS.

SUPREME COURT OF THE UNITED STATES.

No. 145.—October Term, 1893.

W. L. MILLER AND L. W. MILLER, APPELLANTS *vs.* THE EAGLE MANUFACTURING COMPANY.

APPEAL FROM THE CIRCUIT COURT OF THE UNITED STATES FOR THE SOUTHERN DISTRICT OF IOWA. (JANUARY 8, 1894.)

MR. JUSTICE JACKSON delivered the opinion of the Court.

THE appellee as assignee of letters-patent No. 222,767, dated December 16, 1879, and No. 242,497, dated June 7, 1881, issued to Edgar A. Wright, for certain new and useful improvements in wheeled cultivators, brought this suit against the appellants, who were the defendants in the court below, for the alleged infringement thereof.

The defences made in that court were that Wright was not the first and original inventor of the improvements described in the patents; that the same were shown and described in previous devices of letters-patent, set forth in the answer; that the invention shown in each of the patents in suit is identical; that in each the supposed improvements relate to a spring and its attachments; that the function and operation of the parts are exactly the same in each; that one or both of the letters-patent in controversy were issued without authority of law, and therefore, void; that in view of the state of the art at the date of the alleged improvements of Wright, the letters patent granted to him did not exhibit any patentable invention, and for that reason are invalid; that the defendants were not engaged in the manufacture of cultivators, but have sold cultivators manufactured by P. P. Mast & Co., of Springfield, Ohio, constructed under and in accordance with various letters-patent owned by that company; that they sold the cultivators of this company without notice or reason to suppose that they were an infringement of the patents of Wright, and that they do not, in fact, infringe the same.

The class of cultivators to which the Wright patents in question relate are of the ordinary character of wheeled, straddled-row cultivators, having vertical swinging beams, or drag bars, to carry the shovels or plows, suspended from an arch or frame, mounted on two wheels, a tongue fastened to the frame and beams connected with the horizontal portions of the arch, which serves as an axle for the wheels, and surrounding the axle on each side a pipe box, to which the beam is secured, the pipe box revolving on the axle, and the beam carrying the shovels adjusted so as to swing up or down with the pipe box, according to the direction in which it is turned.

The patented device consists of a round steel rod, or wire spring, having at its fixed end a coil attached to the swinging beam, or plow bars, and extending from the coil a slightly curved arm, the outer end of which terminates in a bend or shoulder, from which the rod continues to form a short arm terminating in a sharp bend, or curl, at the free end of the spring. This spring is so adjusted that the outer, or free end thereof, bears against the underside of an adjustable grooved roller, fixed upon an outwardly extending arm upon the upright portion of the axle. This spring, with its adjustment, is intended to have a duplex action, covering the double effect, of either raising or depressing the beams carrying the shovels. The curvature of the spring is such that as it moves along the groove of the roller it presses against the latter at differents points of its periphery, and thereby the direction of its action is shifted or changed, as the position of the swinging beam is changed. Such changes in the direction of its action will assist in drawing or pulling the beam upwards in a vertical direction, giving it increased leverage as the spring is moved forward in its bearings on the roller.

In his original application, filed May 23, 1879, Wright fully described his improved device for use in connection with cultivators and claimed for it, not only its lifting and depressing action, but also its lifting power, which increased as the beams were raised.

An interference with other pending applications being anticipated as to the broad claims of the invention, the application was divided, on November 12, 1879, for the purpose of obtaining one patent for the lifting and depressing effect of the spring on the beams and another for the lifting power of the spring, increasing as the beams rise, the latter being sought upon the original application, while the former was based upon the divisional application of November 12, 1879. Patent No. 222,767, for the double effect or duplex action of the improved spring, was granted on December 16, 1879, and thereafter on June 7, 1881, patent No. 242,497, for the single effect of increased lifting force in raising the plow beams, was granted, after interference had been disposed of.

The Court below sustained the validity of both patents, and held that the defendants infringed the first, second, third, fourth and sixth claims of patent No. 222,767, and the first, second, third and fourth claims of the patents granted June 7, 1881 (No. 242,497). The complainant waiving an accounting for profits and damages, a final decree was entered, enjoining the defendants from making, using or selling to others to be used, cultivators constructed and operated in the manner, and upon the principle described in the letters-patent in controversy. From this decree the present appeal is prosecuted.

The appellants assign numerous errors, which need not separately be noticed and considered, as they are embraced in the general proposition that the court erred in holding that the patents sued on were valid, and that the cultivators sold by the defendants infringed the same. In the specification, forming part of the letters-patent 222,767, issued December 16, 1879, under the divided application filed November 12, 1879, the patentee states:

"The object of my invention is to give the operator mechanical assistance in raising and lowering the plows without interfering with their usual action and movement, to prevent the plows from rising out of the ground accidentially, and to limit their descent; and to this end the invention consists in a spring which serves the double purpose of lifting or holding down the plows at will, as may be required; in so constructing and applying a spring that it exerts a lifting action on the plow only when the latter is raised above its usual operative position; in so constructing and applying a spring that it limits the descent of the plow; also, in details of minor importance, hereinafter described.

"In carrying out my invention the one spring may be adapted to serve all or either one or more of the offices above enumerated, and may be modified in its form, construction and arrangement, as desired, provided its mode of action is retained."

[Here follow extracts from the specifications of both patents and their claims.]

It is not deemed necessary to make a separate analysis of the respective claims alleged to be infringed.

The novelty of Wright's invention consists, as held by the court below, in the application of a double acting spring to assist the operator in either lifting the plow beams, or the plows attached thereto, or in sinking them deeper in the earth, as occasion might require, while the cultivator is in service. The first patent, issued in 1879, covered both the lifting and the pressing actions or operations, while the second patent covered only the lifting effect. The spring device which was designed to accomplish these effects, or operations, is the same in both patents. The drawings in each of the patents are identical, and the specification in each is substantially the same. Under these circumstances can it be held that the second patent has any validity, or must it be treated as having been anticipated by the grant of the 1879 patent? If, upon a proper construction of the two patents—which presents a question of law to be determined by the court (Heald *vs.* Rice, 104 U. S., 749), and which does not seem to have been passed upon and decided by the court below—they should be considered as covering the same invention, then the later must be declared void, under the well-settled rule that two valid patents for the same invention cannot be granted either to the same or to a different party.

Thus in Suffolk Company vs. Hayden (3 Wall. 315) it was held that where two patents, showing the same invention or device, were issued to the same party, the later one was void, although the application for it was first filed, thereby deciding that it is the issue date and not the filing date which determines priority to patents issued to the same inventor on the same machine.

In James vs. Campbell (104 U. S., 382), the court say: "It is hardly necessary to remark that a patentee could not include in a subsequent patent any invention embraced or *described* in a prior one, granted to himself, any more than he could an invention embraced or described in a prior patent granted to a third person. Indeed, not so well; because he *might* get a patent for an invention before patented to a third person in this country, if he could show that he was the first and original inventor, and if he should have an interference declared. . . . If he was the author of *any other* invention than that which the specification describes and claims, though he might have asked to have it patented at the same time, and in the same patent, yet, if he has not done so, and afterwards desired to secure it, he is bound to make a new and distinct specification for that purpose, and make it the subject of a new and different patent." When a patentee anticipates himself, he cannot, in the nature of things, give validity to the second patent.

In Mosler Safe Company v. Mosler, (127 U. S. 355,) it was held that a patent having issued for a product, as made by a certain process, a later patent could not be granted for the process which results in the product.

In McCreary v. Pennsylvania Canal Co., (141 U. S. 467,) it was held that where a party owned two patents showing substantially the same improvement, the second was void, the court saying: "It is true that the combination of the earlier patent in this case is substantially contained in the later. If it be identical with it, or only a colorable variation from it, the second patent would be void, as a patentee cannot take two patents for the same invention."

In Underwood v. Gerber, (149 U. S. 224,) it was ruled that where a patentee obtained two patents on the same day, upon applications filed on the same day, they could not be treated as one patent with two claims, and that the complainant in suing upon the second, or the one having the latest number, could not use the first, or the one with the earlier number, to help sustain the action.

In Odiorne v. Amesbury Nail Factory, (2 Mason, 28,) the reason for the rule since established by the above cited cases was stated to be that the power to create a monopoly is exhausted by the first patent; and for the further reason that a new and later patent for the same invention would operate to extend or prolong the monopoly beyond the period allowed by law.

The result of the foregoing and other authorities is that no patent can issue for an invention actually covered by a former patent especially to the same patentee, although the terms of the claims may differ; that the second patent, although containing a broader claim, more generical in its character, than the specific claims contained in the prior patent, is also void; but that where the second patent covers matter described in the prior patent, essentially distinct and separable from the invention covered thereby, and claims made thereunder, its validity may be sustained.

In the last class of cases it must distinctly appear that the invention covered by the later patent was a separate invention distinctly different and independent from that covered by the first patent; in other words, it must be something substantially different from that comprehended in the first patent. It must consist in something more than a mere distinction of the breadth or scope of the claims of each patent. If the case comes within the first or second of the above classes, the second patent is absolutely void.

It is insisted on the part of the appellee that "whether this invention shall be protected in part of its *features* by one patent and as to the rest by another, or shall be completely protected by single patent, is a matter which concerns solely the Patent Office and the inventor." Under the rule announced in the foregoing authorities this proposition cannot be sustained.

The second and principal contention of the appellee is that the patent of 1881 covers a distinct and separate invention from the first, and in support of that proposition the appellee relies upon the rule announced in Garrett v. Seiber, (98 U. S. 77); Sewell v. Jones (91 U. S. 190,) and Merrill v. Yeomans, (94 U. S. 94.) These cases do not, however, establish the appellee's position.

In Garrett v. Seiber the arrangement for the operation of the device in the second patent was entirely different from the original patent. In Sewall v. Jones, it was held that there might be a patent for the process and one for the product. In Merrill v. Yeomans it was held that where a patent described an apparatus, a process, and a product, and the claims covered only the apparatus and the process, the law provided a remedy by surrender of the patent and a reissue for the purpose of embracing the product.

A single invention may include both the machine and the manufacture it creates, and in such cases, if the inventions are really separable, the inventor may be entitled to a monopoly of each. It is settled also that an inventor may make a new improvement on his own invention of a patentable character, for which he may obtain a separate patent, and the cases cited by the appellee come to this point, and to this point only, that a later patent may be granted where the invention is clearly distinct from and independent of, one previously patented.

It clearly appears from a comparison of the two patents and their two respective specifications and drawings, that the first function or object of the patent of 1879, relating to the lifting power of the spring, is identical with the sole object or function covered by the patent of 1881, and that the improved device and combination for the accomplishment of the lifting operation are identical in both patents.

* * * *

The first patent clearly includes the second. No substantial distinction can be drawn between the two, which have the same elements in combination and the same spring arrangement and adjustment to accomplish precisely the same lifting effect, increasing as the beams are raised from their operative positions. The matter sought to be covered by the second patent is inseparably involved in the matter embraced in the former patent, and this, under the authorities, renders the second patent void.

If the two patents in question had been granted to different parties, it admits of no question that the last would have been held an infringement of the first, for the reason that the patent of 1879 just as clearly includes as a part of the invention the increased lifting effect of the spring device, increasing as the beams are raised, as that disclosed in the patent of 1881. It certainly did not involve patentable novelty to drop or omit from the patent a claim for the depressing action of the spring arrangement which might be effected by any mere mechanical contrivance.

* * * *

This statement admits that the peculiar construction of the spring device, by means of which the lifting effect was to be accomplished, was already covered in a patent previously granted to the patentee—referring to the patent of 1879. In thus admitting the existence of a prior patented device, identical with that described in the second specification and drawings, it is difficult to understand upon what principle the patentee can be allowed to withdraw from the operation of such prior patent, one of its distinct elements, and make it the subject of a second distinct patent. It is not the result, effect, or purpose to be accomplished which constitutes invention, or entitles a party to a patent, but the mechanical means or instrumentalities by which the object sought is to be attained, but a patentee cannot so split up his invention for the purpose of securing additional results, or of extending or of prolonging the life of any or all of its elemental parts. Patents cover the means employed to effect results. (Rubber Pencil Company v. Howard, 20 Wall. 507; Fuller v. Yentzer, 94 U. S. 288.)

The prior invention covered the means and the only means, by which the results sought by the patent of 1881 were to be accomplished, and it is settled that the patentee of such prior device would be entitled to all its uses, whether described or not. (Roberts v. Royer, 91 U. S. 105; Stow v. Chicago, 104 U. S., 547.) Under these authorities a single element or function of a patented invention cannot be made the subject of a separate and subsequent patent, and it, therefore, follows that this increased lifting effect of the spring device, sought to be covered by the 1881 patent, being clearly shown and described in the specification, drawings, and claims of the 1879 patent, was not the subject-matter of a valid patent.

This conclusion is no way affected by the reservation attempted to be made in the 1879 patent of the "broad idea of a lifting spring which acts with increasing force as the beam rises," for the reason that the broad idea sought to be reserved is embodied in identically the same mechanical device constituting the invention and covered by the first patent which completely occupies all the ground that was reserved. The spring and its connecting apparatus is the same in each patent, and the claims of the first covered the double automatic action—*upward or downward.* There is nothing in the specification or claims to indicate that in the first patent the lifting action is in any degree slighter or weaker as the beam rises than in the second patent. On the contrary, both specifications clearly indicate that the spring device acts with increasing force in each patent as the beam rises.

In addition to this it distinctly appears that every claim of the 1881 patent could have been properly included and made a part of the claims of the 1879 patent. With the exception of the first broad claim of the 1881 patent, each of the other claims include the spring device with the limiting and qualifying words, "substantially as described," and by virtue of its reference to the specification, the lifting element of the spring device is shown to be the same in each patent. There is nothing in either patent or the specification or claims thereof, to indicate that there is any greater or stronger lifting action in the one than in the other. It is thus shown that one and the same mechanical device, which covers the entire invention, is described in each of the patents; and the effort to secure a second patent on one part thereof or on its function, after such part or its action had been clearly described and covered by a prior patent, cannot be sustained.

To hold under these circumstances that the first and second patents in respect to the lifting effect of the same spring device, present distinct inventions, or that both are valid for the same invention, would involve the drawing of distinctions too refined for the practical administration of the patent law.

* * * *

[Here follows a discussion of the patents to other inventors as related to the construction of Wright's 1879 patent, in view of the state of the art.]

Our conclusion on the whole case is that the patent of 1881 is anticipated by that of 1879; that the first claim thereof is anticipated by the Brown patent; that the patent of 1879, in view of the state of the art, is to be limited and restricted, if it has any validity at all, to the specific spring therein described; and, as thus restricted, it is clearly not infringed.

We are, therefore, of opinion that the decree of the court below should be reversed, and the cause remanded, with directions to dismiss the bill; and it is accordingly so ordered.

THE UNION PACIFIC WIRES—W. U. MAY OPERATE THEM.

At St. Louis, on Jan. 30, Judges Caldwell, Thayer and Sanborn, sitting in the United States Court of Appeals, reviewed the case of the Union Pacific Railroad Company and the Western Union Telegraph Company, appellants, against the United States, appellee. It came up on an appeal from the Circuit Court of the United States for the district of Omaha. Judge Thayer reversed the decision of the Omaha Court and ordered an amended decree. The decision winds up an important piece of litigation. The case involved an alleged infringement of the Pacific Railroad Acts by the Union Pacific Railroad, as, being bound to build and operate by its own servants and agents a line of telegraph for commercial and government purposes between Omaha and Ogden, it had leased its wires, poles, etc., to the Atlantic and Pacific Telegraph Company on July 1, 1881, surrended its franchise and alienated its powers under its charter to the Western Union Telegraph Company. The prayer of the bill was for a decree annulling the contracts between the road and the telegraph company and ordering the road to operate the telegraph lines itself in accordance with law. The Circuit Court granted the prayer. Judge Thayer holds that Congress could not grant to the railway a telegraphic franchise and so limit the power to exercise or deal with it as to make it a burden.

INCANDESCENT LAMP LITIGATION.

USERS ENJOINED IN PHILADELPHIA.

Opinion of Judge Acheson, in the three cases of Edison Electric Light Co. [General Electric Co.] and The Edison Electric Light Co., of Philadelphia, against (1) The Philadelphia Trust, Safe Deposit and Insurance Co.; (2) The Manufacturers' Club of Philadelphia: and (3) The Spreckels Sugar Refining Co.; U. S. Circuit Court for the Eastern District of Pennsylvania, January 25, 1894.

Subjoined is the text of the decision of which note was made in these columns last week :—

ACHESON, Cir. J. :

The patent in suit No. 223,898, granted on January 27, 1880, to Thomas A. Edison, after protracted litigation and a most vigorous defense, was sustained by the Circuit Court of the United States for the Southern District of New York and by the Circuit Court of Appeals for the Second Circuit. (Edison Electric Light Company vs. The United States Electric Lighting Company, 47 Fed. Rep., 454; 52 Fed. Rep., 300; Edison Electric Light Company *et al.* vs. The Sawyer-Man Electric Company 53 Fed. Rep.. 592.) The uncontradicted proofs in the several cases now before me show infringing use by the defendants respectively, and it is conceded that the plaintiffs—Edison Electric Light Company and its exclusive licensee in the City of Philadelphia, The Edison Electric Light Company of Philadelphia—are entitled to a preliminary injunction in each of these three suits. The Court, however, is asked to exempt from the operation of the injunction certain lamps (confessedly within the second claim of the patent) which were manufactured by the Columbia Incandescent Lamp Company, a corporation of the State of Missouri, for the reason that, in a suit brought against that company by the Edison Electric Light Company and the Edison General Electric Company in the Circuit Court of the United States for the Eastern District of Missouri after the decisions in the Second Circuit, Judge HALLETT refused a motion for a preliminary injunction upon the defendants giving bond in the penal sum of twenty thousand dollars, condition for the payment of any sums which might be decreed in that suit in favor of the complainants therein. (56 Fed. Rep., 496). The ground for this refusal was a defense then set up, which had not been made in the Circuit Court, that the incandescent electric lamp for which Edison was granted the patent was only the prior invention of one Henry Goebel. But in the earlier case of the *Edison Electric Light Co. vs. Beacon Vacuum Pump and Electrical Company*, 54 Fed. Rep., 678, that defense was interposed to a motion for a preliminary injunction, and was very carefully investigated by Judge COLT, who found and decided that Goebel's story of his invention in itself was so improbable, and the evidence to sustain the alleged anticipation was of such doubtful character that the consideration of this defence ought to be postponed until final hearing, and that in the meantime the plaintiff was entitled to enjoy the fruits of the decree sustaining the patent. Accordingly, Judge COLT granted a preliminary injunction.

In the more recent case of the Edison Electric Light Company vs. Electric Manufacturing Company, 57 Fed. Rep., 616, in the Circuit Court of the United States for the Eastern District of Wisconsin, Judge SEAMAN expressed views similar to those of Judge COLT, and awarded a preliminary injunction to restrain infringement of this patent.

No evidence whatever in support of the Goebel defense has been submitted to me, so that I am without means of forming an independent opinion as to whether it rests upon a substantial basis. Under all the circumstances, then, to give to Judge HALLETT's refusal to grant an injunction the effect here claimed for it would be to carry the principle of judicial comity to a most extravagant length. The Edison Electric Light Company of Philadelphia, vitally interested here, is not a party to the Missouri suit. But aside from that consideration, the owner of a patent undoubtedly may maintain suits for infringement against the manufacturers and users of the patented device simultaneously. (Birdsell vs. Shalliott, 112 U. S., 485; Kelley vs. Ypsilanti Dress Stay Manufacturing Company, 44 Fed. Rep., 19). True, pending a test suit against a manufacturer involving the validity of a patent in which a preliminary injunction against him has been decreed, Courts in other jurisdictions have declined to enjoin preliminarily the users of the device. But the Edison Patent has been sustained under circumstances which entitle the adjudication to high regard. It is the accepted doctrine that the decision of the Supreme Court, after exhaustive litigation upon the merits sustaining a patent, will ordinarily be regarded as conclusive on a motion for a preliminary injunction, the presumption against the existence of any valid defense against the patent prevailing at that stage of the case. (Purifier Co. vs. Christian, 3 Bann & Ad., 42, 51; Am. Bell Tel. Co. vs. Southern Tel. Co., 34 Fed. Rep., 795; American Bell Tel. Co. vs. McKeesport Tel. Co., 57 Fed. Rep., 661). I think the same effect ought here to be accorded to the decision of the United States Circuit Court of Appeals for the Second Circuit, sustaining the Edison Patent.

In each of these cases a preliminary injunction in the form prescribed by the Courts of the Second Circuit will be allowed.

THE NOVAK CASE ON APPEAL.

THE Novak lamp case, which was heard at Hartford, Conn., before Judge Shipman, came up on appeal before the Circuit Court of Appeals at New York, on Jan. 30, before Judges Wallace and Lacombe.

The Waring Company was represented by Messrs. Simonds and Morse and the Edison Electric Light Co. (The General Electric Co.) by Messrs. Fish and Dyer. The arguments, which occupied three hours, traversed much the same ground as that covered in the case before Judge Shipman. At their conclusion the Court took the papers for further consideration and decision.

ELECTRIC MOTORS EXEMPT FROM TAXATION.

The Judges of the Appeal Tax Court of Baltimore in accordance with an opinion of a city law officer, have decided not to tax electricity as a motive power. The court previously decided to levy an assessment on all machinery moved by electricity. This would have affected all business houses in Baltimore using electricity and it was regarded as a discrimination. The court will now exempt electrical machines and tax only the plants of the electric companies, as was intended by the law.

EDISON E. L. CO. vs. MATHER ELECTRIC CO.—MOTION FOR TIME GRANTED.

On motion of the defendants in the case of the Edison Electric Light Company against the Mather Electric Company of Manchester, this State, Judge Shipman in the United States Circuit Court has granted a continuance of time to the defendant to file an answer in suit. Charles E. Perkins, counsel for the defendants, argued for the motion and Albert H. Walker, counsel for the plaintiff, against it. The suit is brought on the ground that the defendants are infringing the compound winding method patented by Edison. Judge Shipman allowed the motion and gave the defendants until the first Monday in March to file their answer.

A DECISION THAT THE W. U. IS A COMMON CARRIER UNDER THE INTERSTATE COMMERCE LAW.

An important decision was handed down last week by Judge Smith, of the Court of Appeals at Kansas City, Mo. This decision affirms that a telegraph company is as much a common carrier as a railroad or express company and that as such when it carries on an interstate business it is subject to the control of the Interstate Commerce Commission. The suit was an ordinary one brought against the Western Union Telegraph Company to enforce a statutory penalty of $200 for failure to properly transmit a telegram. As a number of constitutional questions arose in the conduct of the case, it was carried to the Missouri Supreme Court for settlement.

UNDERGROUND RAILWAY WIRES IN KENTUCKY.

A BILL has been introduced in the Kentucky Legislature providing that in all cities of the State all electric street railways shall be compelled to put their wires underground. No penalty is attached for failure to obey the law, but it is provided that upon failure or refusal to comply the city authorities may take the work in hand, and have it done at the expense of the corporation owning or operating the railway. Any city may inforce the provisions of the law by mandamus proceedings.

"RECORDS FOR THE BENEFIT OF PRINTERS."

THE record in the case of The Consolidated Electric Light Company versus the McKeesport Light Company, involving the great contest being waged between the leading electric light corporations of the United States, comprises three large volumes, and its printing cost $7,000. This includes the cost of engraving, there being a great number of illustrations in the work.

CHEAP SERVICE IN TRURO, N. S.

THERE is war in Truro over telephone affairs. The Chambers Electric Light and Power Company are installing a system of telephone worked free of charge. The company undertakes to light a house throughout by electricity, put in and work a telephone and provide an instantaneous fire alarm, all for the sum of $25 per year, the price asked for telephone connection alone by the Telephone Company. Naturally the latter company objects, and a strong rivalry exists.

SOCIETY AND CLUB NOTES.

FOURTH ANNUAL BALL OF THE MASSACHUSETTS ELECTRICAL ENGINEERS AND MECHANICS ASSOCIATION.

The above ball was held in Copley Hall, Boston, on the evening of Monday, January 29th, and in spite of the inclemency of the weather was a huge success in every way. As usual the electric lighting decorations formed a most important feature, and the committee in charge fairly excelled all previous efforts in this direction. Outside, illuminating the street leading to the hall for a distance of about 300 yards, arc lights had been suspended, with crimson shades, throwing a warm red glow on the masses of snow, and looking very comfortable and cheering in the frightful storm that prevailed. Inside, the magnitude of the illumination almost beggars description. Some 3000 incandescent lights were used. At the top of the hall was a ball seven feet in diameter, studded with incandescent lights of 16-candle power each, with globes colored red, white and blue. This ball was kept slowly revolving by means of an electric motor, and a commutator on its axis switched the current first into the red bulbs, then the white, and finally the blue, producing an effect of great beauty. Streamers of incandescent lights extended from the ball to the sides of the hall. These streamers changed colors in unison with the ball. At the rear of the hall were two immense towers from floor to ceiling, each carrying about 350 lights. The lights on these towers were on six different circuits, and as the lamps were of different colors, a beautiful variation of effect was produced at will. The whole lighting was controlled by a switchboard at the back of the orchestra, which was eagerly examined by those present.

On the side walls were two large signs, built of incandescent bulbs, one reading "Welcome to Our 4th" and the other "M. E. E. and M. A., 1890–1894." The current could be sent through either the red or the white globes, as the operator at the switchboard dictated. He kept the dancers entertained in rare fashion. First the hall would be plunged in blue, then in red and white, or in a mixture of all the above colors and green. Scattered around the hall were half a dozen unique displays, also under the control of the switchboard. Two big stars, a sign "Edison," and the monogram, "G. E. Co.," meaning General Electric Company, were prominent. Flags, banners and streamers were used to fill up the bare spaces on the walls and set off the electric lights.

All the decorations were installed by members of the Association, and they are to be congratulated on the beautiful effects produced. About 2,000 people were present and a large sum was netted for the funds of the Association which is in a most flourishing condition. Much credit is due to the members of the different committees who have worked hard to make the ball a success, and they have every reason to be well pleased with the success of their labors. The committee on the ball was composed of the following gentlemen: James E. Cole, Harry Cottle, Joseph L. Winn, J. A. Collicott, and Walter J. Burke.

DR. WHEELER ON DYNAMOS & MOTORS.

A most interesting and instructive lecture in the Electrical Workers' University Extension Course was delivered on January 29, by Dr. S. S. Wheeler, whose subject was "Direct Current Dynamos and Motors." It was well illustrated by apparatus in operation, including some of the combination motor-tools to which the lecturer has himself devoted so much time and ingenuity. All the principles and features of direct current generation and motive power were taken up in brief, succinct review, and the audience gathered an immense amount of helpful information in a very short time.

CHICAGO ELECTRICAL ASSOCIATION.

The officers of this society for the present year are: President, Albert Scheible; Vice Pres't, W. D. Ray; Secretary, H. G. Dimick (227 South Clinton St.); Treasurer, F. S. Hickok; Librarian, E. F. Norton (Room 15 City Hall). At the last meeting Mr. W. Clyde Jones read a carefully prepared paper on "The Development of the Telephone."

N. E. L. A.

SECRETARY G. F. PORTER has addressed a circular letter to over 500 electric street railway companies, calling their attention to the fact that several of the topics to be taken up at the Washington meeting this month are of interest to them and should lead them to be represented.

MR. NEWTON L. SCHLOSS, who is well-known in electrical circles in New York, delivered a lecture on The Phonograph on Jan. 23, before America Lodge of the Independant Order B'nai B'rith. The meeting was largely attended and the talk proved very interesting to the members.

MONTREAL ELECTRIC CLUB.—At the annual meeting held on Jan. 15th, the reports for the past year of the secretary and treasurer showed the club to be in a flourishing condition; there being a large increase in the membership and a considerable balance in the treasury. The election of officers for the ensuing year resulted as follows: President, W. B. Shaw; vice-president, H. Ritchie; secretary, Jas. Burnett; treasurer, L. M. Pinolet; committee of management, H. Brown, Jas. Douglas and Howard D. Black.

NIAGARA AT WORK.

THE NIAGARA FALLS PAPER COMPANY, the first to make use of the newly developed water power of the falls, commenced operations at eleven o'clock on the morning of January 25, everything worked smoothly and to the utmost satisfaction of the officers who witnessed the start. The wheel house of the paper mill is of brick, iron and slate, built over the wheel pit 20 by 40 feet in section, and 155 feet deep. The pit is cut through the solid rock and lined with massive masonry to the level of the ground. Water is led from the river through a canal 240 feet long protected by three iron gratings and three sets of gates. The penstocks are 13 feet in diameter and the turbines are of 3,300 h. p. each. At present only one is in position, but another will be added later. At the top of the vertical shaft is a horizontal bevel gear meshing with three vertical gears, two of which turn the pulp grinders while the third is connected to the line shafting. From the bottom of the wheel pit a tunnel connects with that of the Niagara Falls Power Company.

The Niagara Falls Paper Company was organized about five years ago and its output will be about three car loads daily.

MR. F. S. TERRY.

THE office of secretary of the Sunbeam Lamp Mfg. Co., Chicago, has been accepted by Mr. F. S. Terry, who will now give his entire attention to pushing the sales of that company. Mr. Terry's connection with the Ansonia Electric Co. has now entirely ceased, and the branch in Chicago will go out of existence as such. It may not be generally known that Mr. Terry's relationship with the Ansonia Electric Co., or as it was formerly called, the Electrical Supply Co., had endured continuously from the Company's organization in 1885, when he and it practically began business life together. He was its first office employee, attending at that time to all the correspondence, bookkeeping and all other office work. In the winter of 1884–5, Mr. Terry went to Chicago to open the western branch, and he saw and promoted its remarkable development down to the end of his fourteen years of vigilent, unremitting service. A host of friends will desire for him renewed prosperity under the change of conditions and with the return of commercial affairs to their normal volume and activity.

MR. J. F. KELLY.

THE NATIONAL ELECTRIC CO. of Eau Claire, Wis., will now be represented in this part of the country by Mr. J. F. Kelly, who becomes its General Eastern Agent. He has opened offices at 906 Temple Court, 5-9 Beekman street, New York, and will be glad to receive correspondence and inquiries there. Mr. Kelly has a very wide circle of acquaintance in electrical engineering and trade circles. He was at one time connected with the old Electrical Supply Co. in this city, and afterwards represented the wire department of the Edison Machine Works. His services were transferred later on to the Edison General Co. and the General Electric Co.

EDISON ELECTRIC LIGHT COMPANY EARNINGS IN PHILADELPHIA.

THE annual report of the Edison Electric Light Company of Philadelphia shows that the company have paid out in dividends during 1893, $152,244 in four separate payments of two per cent. each, and one extra payment of two per cent. The surplus earnings of the year were $48,398 83, and the profits of 1893 were $200,642.83. The cost of extensions last year was nearly $297,000. Of this $238,000 was expended on work which will require about $82.000 for its completion.

The reduction of the price of gas to $1 per 1,000 cubic feet, the Board stated, has not and will not likely affect the increasing demand for current. The assets are given at $1,740,825.01.

The present directors have been re-elected without opposition, as follows: William D. Marks, Samuel B. Huey, Charles M. Swain, Amos R. Little, John Lucas, H. Blake Tyler, D. S. Lindsay, L. D. Brown, Arthur Colburn, William T. Tiers and C. A. Coffin.

AMERICAN BELL CAPITAL TO BE $50,000,000.

THE AMERICAN BELL TELEPHONE CO. have filed an application at the Massachusetts State House for permission to increase their capital $30,000,000, making the total capitalization $50,000,000. The money is needed for new work and extensions of various kinds, and some of it may be used for the further absorption of sub-companies.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 16, 1894.

Accumulators :—

Process of Making Secondary Battery Plates, W. L. Silvey, Dayton, O., 512,757. Filed Sept. 12, 1892.

The process consists in immersing anodes of lead or lead alloy and cathodes of lead in a solution of ammonia and an acid, then disintergrating the anodes by the aid of an electric current and electrically depositing the parts thus decomposed in holes in the cathodes.

Secondary Battery, A. Hough, San Francisco, Cal., 512,823. Filed Sept. 14, 1893.

The active material consists of a mixture of mon-oxide of lead, sulphate of ammonia and sulphate of magnesia, the sulphate of ammonia being decomposed and the sulphate of magnesia dissolved.

Alarms and Signals :—

Railroad Signal, C. Selden, Baltimore, Md., 512,754. Filed Feb. 1, 1893.

An electric system of block signals for steam railways.

Distribution :—

Continuous Electric Current Distributing System, M. Von Dolivo-Dobrowolsky, Berlin, Germany, 513,006. Filed Nov. 24, 1893.

Claim 1 follows :—

In a system for distributing electricity two series connected groups of consuming apparatus fed by two main conductors and a compensating conductor and a continuous current dynamo connected with the mains and a coil of high self-induction connected at both ends with diametrically opposed points of the armature winding of said dynamo, and in its centre with the said compensating conductor.

Dynamos and Motors :—

Motor Generator, J. C. Henry, Westfield, N. J., 512,890. Filed Apl. 29. 1892.

Claim 1 follows : –

In a magneto-electric machine the combination of suitable field magnets, two armatures carried by a single shaft and a single support for said shaft, between the armatures.

Ceiling Fan Motor, W. Hochhausen, Brooklyn, N. Y., 512,821. Filed Sept. 4, 1891.

Dynamo Electric Machine or Motor, H. S. Rodgers, Hartford, Conn., 512,543. Filed Jan. 31, 1893.

Claim 1 follows :

A dynamo electric machine or motor having its field-magnet cores provided with pole tips or horns lying within the planes bounding the external surface of the cores, whereby the field-magnet coils may be put in position or removed without removal of the cores.

Commutator and Connector for Dynamos, G. Wilkes, Detroit, Mich., 512,858. Filed October 2, 1893.

Provides a construction and connection of the armature and commutator of a multipolar machine that will provide only two paths for the current in the armature conductors ; and also establish a ratio of two to one between the number of segments in the commutator and the number of slots and coils.

Automatic Regulator for Dynamo Electric Machines, E. A. Sperry, Cleveland, O., and G. E. Mills, Ravenswood, Ill., 513,068. Filed April 25, 1892.

Consists of mechanism for automatically rotating the field magnet of a dynamo to regulate the current generator.

Galvanic and Thermo-Electric Batteries :—

Excitant for Voltaic Cells, G. Hewett, New York, 512,069. Filed April 3, 1893. Consists of sulphuric acid and sulphate of soda prepared in a dry state.

Heating :—

Electric Heater, W. J. Bowen, Norwalk, Ohio, 512,797. Filed Apl. 14, 1893.

The heating conductor is so arranged as to impart its heat to a series of tubes into one end of which cold air is forced which is heated by its passage through the tubes.

Lamps and Appurtenances :—

Electric Arc Lamp, C. J. Hartley, Decatur, Ill., 512,880. Filed Mch. 31, 1893.

Provides means for increasing or diminishing the effect of the derived circuit in the carbon carrying core.

Electric Search Light, C. E. Ongley, New York, 513,052. Filed Aug. 22, 1893.

Relates especially to means for flashing the light for signal purposes.

Metallurgical :—

Process of Manufacturing Aluminum, W. E. Case, Auburn, N. Y., 512,801. Filed March 13, 1893.

The process consists in combining aluminum sulphate and calcium fluoride to form an aluminum fluorsulphate solution, adding thereto a caustic alkali, and then removing, fusing and electrolyzing the precipitate.

Process of Manufacturing Aluminum, W. E. Case, Auburn, N. Y., 512,802. Filed Mch. 13, 1893.

Similar to No. 512,801.

Miscellaneous :—

Electric Washing Machine, J. P. Johanson, New York, 512,970. Filed May 9, 1893.

Apparatus for Electrically Treating Raw Hides, P. R. De F. D'Humy. Chicago, Ill., 512,706 Filed Feb. 4, 1893.

Electric Inhaler, R. L. Larcom, Fandon, Ill., 512,723. Filed Sept. 29, 1893.

Machine for Winding Electro-Magnets, R. Varley, Jr., Englewood, N. J., 512,769. Filed Apr. 13, 1893.

Railways and Appliances :—

Rail Bond Connector for Electric Railways, H. R. Keithley, Chicago, Ill., 512,711. Filed Feb. 27, 1893.

Has thimble shaped terminals adapted to be expanded after being placed within the holes in the rails.

Trolley-Wire Insulator, H. H. Luscomb, Hartford, Conn., 512,888. Filed Oct. 18, 1893.

Relates to certain details in the construction of trolley wire hangers.

Battery System for Electric Railways, L. B. Rowley, Ashland, Wis., 512,907. Filed Feb. 15. 1893.

Consists of a main circuit including in multiple arc two or more independent sets of batteries, a working circuit and means for automatically switching the set of batteries bodily and individually from one circuit to the other.

Electric Railway Trolley, W. Van Benthuysen, New Orleans, La., 512,923. Filed March 24. 1893.

Claim 2 follows :

A trolley wheel, made in the form of a cone, with a concave flange of smaller diameter than the cone formed on its smaller end.

Electric Railway Trolley, G. W. Mackenzie, Beaver, Pa., 513,028. Filed, April 5, 1893.

Has, instead of the trolley wheel, two independent vertical, conical rollers between which the trolley wire passes.

Switches and Cut-Outs :—

Electric Switch, E. P Warner, Chicago, Ill., 512,774. Filed Dec. 1, 1891.

Consists of two pairs of slit contact plates, one connected to each of the terminals, and a switching block sliding between the two members of one pair so as to bridge the space separating the opposed ends of the pairs and making contact with the second pair of plates.

Automatic Electro Magnetic Switch, H. P. White, Philadelphia, Pa., 513,065. Filed Sept. 25, 1893.

Telegraphs :—

Sextuplex Telegraph, T. A. Edison, Menlo Park, New Jersey, 512,872. Filed June 2, 1877.

Employs differential relay magnets in the respective circuits in combination with shunt connections around the relay magnet and condensers of nearly equal electrostatic capacity in the respective shunts.

Telephones and Apparatus :—

Switchboard, W. A. Childs, Englewood, N. J., 512,805. Filed Oct. 25, 1893.

Has for its object to provide means for readily removing the entire cord, plug and weight from a telephone switchboard, should it become faulty, and inserting another in its place.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 23, 1894.

Accumulators :—

Secondary Battery, E. & L. Paget, New York, 513,245. Filed Feb. 9, 1893.

The electrodes are treated in a heated solution of a metallic nitrate yielding an oxide of the metal that is insoluble in water.

Alarms and Signals :—

Electric Bell, C. Turnbull, Jr., North Shields, England, 513,219. Filed July 24, 1893.

Has especially for its object the regulation and adjustment of the stroke.

Electric Bell, C. Turnbull, Jr., North Shields, England, 513,220. Filed Nov. 11, 1893.

Similar in its object to No. 513,219

Electro Mechanical Gong, N. H. Suren, New York, 513,251. Filed Oct. 11, 1893.

Electric Call-Bell for Pneumatic Tubes, L. Strouse, Baltimore, Md., 513,345. Filed April 6, 1893.

Annunciator System, A. L. Vogt, Delaware, Ohio, 513,352. Filed March 8, 1893.

A device for expediting communication between physicians and their patients.

Railway Signaling Apparatus, E. A. Winterhalder, Kappel, Germany, 513,376. Filed Dec. 3, 1892.

An electric block system for single track steam railways.

Distribution :—

Means for Neutralizing Self Induction in Alternating Currents, E. Thomson and E. W. Rice, Jr., Swampscott, Mass., 513,349. Filed Sept. 1, 1893.

Employs a condenser connected inductively with the circuit through a transformer of such a ratio of transformation that the potential in the condenser circuit is greater that that in the working circuit of the magnet.

Method of and Apparatus for Preventing Phase Displacement in Alternating Circuits, C. P. Steinmetz, Lynn, Mass., 513,370. Filed Sept. 9, 1893.

Employs condensers or equivalent neutralizers of self induction and provides for the ready regulation of the action of such condensers in accordance with the changes of load.

Dynamos and Motors :—

Electric Elevator, N. P. Otis, Yonkers, N. Y., 513,134. Filed June 25, 1890.

Electric Motor Controlling Device, J. E. Stanton, Boston, Mass, 513,213. Filed June 19, 1893.

A controller adapted especially to surgical and dental motors.

Magneto Electric Machine, H. H. Taylor, Los Angeles, Cal., 513,347. Filed Mch. 15, 1893.

Relates especially to certain details of construction to reduce the amount of idle wire in the armature, to reduce air friction between the armature and poles and to facilitate repair.

Dynamo Electric Machine, G. F. Dieckmann, Chicago, Ill., 513,459. Filed Dec. 28, 1892.

Claim 1 follows :

In electric machines, the combination with the field magnet and with its armature helix of a supplemental coil mounted separately from, but located parallel to, said helix and inductively influenced thereby.

Commutatar for Dynamo Electric Machines, H. L. Fee, New Orleans, La., 513,460. Filed July 26, 1893.

Claim :

The combination with the radial arms of a commutator, of the detachable insulating thimbles which are applied to the free ends of said arms and surround the same.

Heating :—

Electric Radiator, W. D. Hough and E. Z. Burns, Niagara Falls N. Y., 513,109. Filed Jan. 9, 1893.

A radiator in which a current is passed through pipes containing a circulating liquid forming a resistance and heat developer.

Lamps and Appurtenances :—

Electric Arc Lamp, W. Jandus, Cleveland, O., 513,111. Filed Oct. 23, 1893.

Claim 1 follows :

In an electric arc lamp, an arc-inclosing chamber closed air-tight at its top and sides, and closed,—but not air-tight,—at its bottom, to allow limited inlet to and free outlet from the chamber.

Electric Light Fixture for Music Stands, W. J. Kelly, Boston, Mass., 513,113. Filed Sept. 19, 1893.

Measurement :—

Electric Meter, J. C. Henry, Westfield, N. J., 513,264. Filed Dec. 21, 1891.

An indicator and register showing the amount of energy being absorbed at the instant of observation and also measuring the total amount consumed during a given time.

Electric Meter, C. Gudgell, Independence, Mo., 513,391. Filed June 21, 1893.

A meter for indicating the rate of consumption of lighting or power currents and also the total amount of current consumed during any given time, actuated by clock work mechanism with an automatic rewinding attachment.

Metal Working :—

Process of and Apparatus for Melting Metals by Means of Electricity, A. F. W. Kreinsen, Hamburg, Germ., 513,270. Filed Sept. 28, 1893.

Consists of an electrode composed of the metal to be melted and a carbon electrode; both located within the cap of the crucible.

Process of Precipitating Metal Sulphide from Hyposulphite Solutions, H. Hirsching, Salt Lake City, Utah, 513,324. Filed May 6, 1893.

The process consists in subjecting the solution to the action of an electric current.

Miscellaneous :—

Phonograph, T. A. Edison, Llewellyn Park, N. J., 513,097. Filed December 8, 1890.

Gas and Electric Coupling, W. J. Kelly, Boston, Mass., 513,112. Filed Sept. 19, 1893.

A combination gas pipe and electric wire coupling for chandeliers, etc.

Automatic Electric Stop Motion for Knitting Machines, J. Buchel, New Orleans, La., 513,259. Filed Mch. 18, 1893.

Electrical Apparatus for Firing Submarine Mines, G. Bertolini, Venice, Italy, 513,294. Filed April 6, 1892.

Electric Gas Lighter, W. L. Brown, San Francisco, Cal., 513,300. Filed June 22, 1893.

Electric Belt, W. C. Fuller, Salina, Kansas, 513,387. Filed Oct. 11, 1893.

Method of Cooling the Iron of Transformers, H. A. Rowland, Baltimore, Md., 513,420. Filed Feb. 8, 1893.

Employs a current of liquid circulating in juxtaposition to the laminated iron sheet and parallel to the motion of the lines of force.

Method of Cooling Transformers, H. A. Rowland, Baltimore, Md., 513,421. Filed Feb. 8, 1893.

The transformer is surrounded by a volatile liquid which, by boiling, carries away the heat.

Means for Cooling Electric Conductors, H. A. Rowland, Baltimore, Md., 513,422. Filed Feb. 14, 1893.

Claim 1 follows :

The method of cooling hollow conductors carrying electric currents, which consists in passing a conducting fluid through said conductors, and in breaking the electrical continuity of said fluid after it leaves said conductor.

Self-Induction Coil, C. F. Scott, Pittsburgh, Pa., 513,425. Filed Nov. 25, 1892.

The invention provides a laminated core which shall permit the passage of a minimum current at normal voltage, but shall offer as small a resistance to the current as possible when the difference of potential rises beyond a given point.

Resistance Coil, H. P. Davis, Pittsburgh, Pa., 513,457. Filed April 22, 1893.

Electric Clock System, J. H. Gerry and F. M. Schmidt, Brooklyn, N. Y., 513,469. Filed May 16, 1893.

Railways and Appliances :—

Electric Motor for Street Cars, B. G. Lamme, Pittsburgh, Pa., 513,401. Filed Mch. 27, 1893.

Claim 1 follows :

In a motor for electric cars, an armature mounted upon the axle of the car, and two field magnets independently sleeved upon the axle and suspended at their rear ends from the car body.

Span Wire for Overhead Electric Railways, S. H. Short, Cleveland, Ohio, 513,426. Filed April 1, 1890.

The invention consists in dividing the span wire into insulated sections where more than one trolley wire is carried on a single span wire.

Supply System for Electric Railways, H. S. Pruyn, Hoosick Falls, N. Y., 513,440. Filed Sept. 16, 1893.

The invention relates to special construction of conduit systems in which main and secondary conductors are used.

Electrical Means for Propelling Canal Boats, J. Sachs, New York, 513,466. Filed Feb. 15, 1893.

Employs an electric motor running on an elevated track along the banks of the canal.

Switches and Cut-Outs :—

Electric Safety Device for Elevators, R. W. Magrane, Brooklyn, N. Y., 513,122. Filed Mch. 17, 1892.

A switch actuated by the elevator doors having for its object to prevent the movement of the elevator in either direction unless all the doors are closed.

Rheostat, W. Meredith, Aurora, Ill., 513,126. Filed Apl. 20, 1892.

Electric Light Cut-Off, J. B. Stewart, Haverstraw, N. Y., 513,250. Filed June 21, 1893.

Comprises a single magnet, a single armature, a rocking arm mounted on the magnet and provided with a conducting and a non-conducting bar and carrying the electric light terminals.

Automatic Rheostat, B. C. Van Emon, San Francisco, Cal., 513,350. Filed Apl. 4, 1893.

Telephones and Apparatus :—

Microphone, A. Groper, Dusseldorf, Germany, 513,181. Filed Jan. 14, 1893.

Employs a mica diaphragm and a carbon diaphragm with an air space between them and a number of carbon balls normally in contact with the carbon diaphragm.

Telephone Transmitter, F. R. Colvin, New York, N. Y., 513,305. Filed Oct. 10, 1893.

Claim 1 follows :—

A telephone transmitter provided with a diaphragm loosely supported and having its entire rim or outer edge free to vibrate undampened, said diaphragm carrying electrodes fixed with relation to each other, and a resistance varying material between the electrodes.

Apparatus for Registering Telephone Calls, L. Kahn, Hamburg, Germany, 513 364. Filed Mch. 2, 1893.

Relates to a transmitter for producing currents of alternating polarity to operate a printing telegraph at a distant station from the call station, designed to register the number of the latter in the event of the call signal not being heard.

HERTZ'S "ELECTRIC WAVES."

An excellent English translation by Mr. D. E. Jones, with a suggestive preface by Lord Kelvin, has been published by McMillan & Co. It is well got up, and is issued at $2.50. Copies will be furnished from THE ELECTRICAL ENGINEER office, postage free, on receipt of price.

DEATH OF MRS. ALFRED VAIL.

The death is announced of Mrs. Alfred Vail, whose husband is known to fame as Morse's right hand in the invention and development of his electromagnetic telegraph.

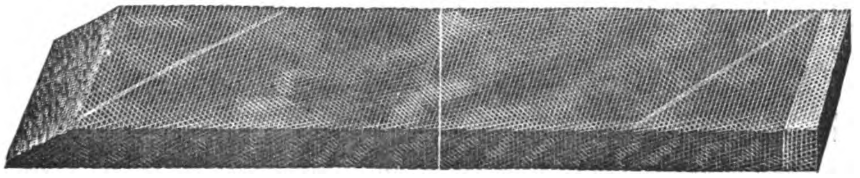
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE FLEMING DYNAMO BRUSH.

PROF. HOUSTON, in his "Dictionary of Electrical Words, Terms and Phrases," describes brushes for dynamo electric machines, as "strips of metals, bundles of wires or slit plates of metal or carbon, that bear on the commutator cylinder, and carry off the current generated." He also goes on to state that "brushes should bear against the commutator cylinder with sufficient force to prevent jumping and consequent burning, and yet not so hard as to cause excessive wear." The brush that we illustrate, for which letters patent have been granted to Mr. W. H. Fleming, E. E., of this city, has many features that commend themselves to all dynamo users. In the first place it is composed of wire gauze, the copper of which is from the Hecla mines, specially drawn and woven to a mesh of 3,600 to the square inch.

The brush is made up of one continuous strip of this gauze, no packing or other foreign substance being introduced, and by the process of manufacture is made to wear uniformly throughout its entire length, with no unravelling of the gauze and no sparking from loose ends. When sufficient gauze has been wound up to make a brush of the desired size, the somewhat loose roll is put into a mould of the proper size and subjected to a heavy pressure in a hydraulic press. In this operation the layers of gauze are pressed into a compact mass, the end of the strip being forced into the layer below so as to make a smooth joint. The brush therefore needs no sewing or other form of fastening, such as has heretofore been found necessary to bind the free end of the strip of the material. The brush, apart from its compactness, strength and durability, is exceedingly flexible. Adapting itself readily to the surface of the commutator, it is always in good metallic contact with it, therefore preventing to a large extent the sparking so destructive to this part of the dynamo.



THE FLEMING WIRE GAUZE DYNAMO BRUSH.

Manufacturers and central station men in all parts of the country, who have used this brush speak most highly of the results obtained. It has been placed on the market by the International Trading & Electric Co., of 40 Cortlandt St.

CARPENTER ENAMEL RHEOSTATS.

THE CARPENTER ENAMEL RHEOSTAT CO. as the assignee of C. E. Carpenter has recently had issued to it, a patent, which, it is claimed, controls broadly all commercial forms of enamel rheostats and heaters. The patent is No. 511,407 of December 26, 1893, and a sample claim reads as follows :

> Claim 1.—The improvement in the method of constructing resistances which consists in attaching to a suitable support a coating of enamel by fusing the same ; placing upon the surface of the coating an electrical conductor, covering said conductor with a coating of enamel having a fusing point lower than the enamel already applied, and raising the whole to a temperature sufficient to fuse said second layer of enamel, substantially as described.

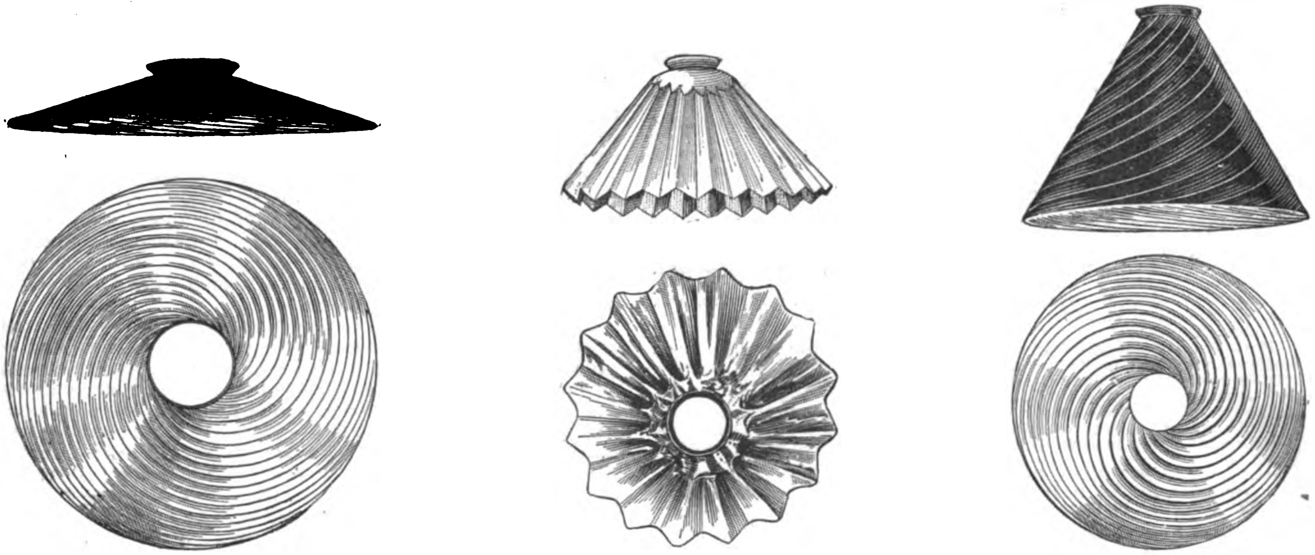
This company will immediately put upon the market a full line of electrically heated appliances, such as soldering irons, flat irons, and glue pots, various kinds of electrically heated tools and electric cooking utensils, such as chafing dishes, coffee pots, ovens, broilers, etc.

The rheostats of this company are now in almost universal use by manufacturers of electrical generators and motors, and by electric contractors. Their theatre dimmers and field rheostats, selling for about one-half the price of all former kinds and having such marked advantages as regards space and safety from fire, have really no competition, and the progressive policy of the company in continuing to make reductions in price, notwithstanding this, is in marked contrast with usual methods of charging high prices because of the protection of fundamental patents. The wisdom of this policy is evident from the favor, with which this rheostat has been received by the electrical public.

The following agencies of the company have recently been established: Walker & Kepler, Philadelphia; Sargent & Lundy, Chicago; Owen Ford, St. Louis; William Oswald, New Orleans.

GLEASON'S STANDARD SILVERED GLASS REFLECTORS.

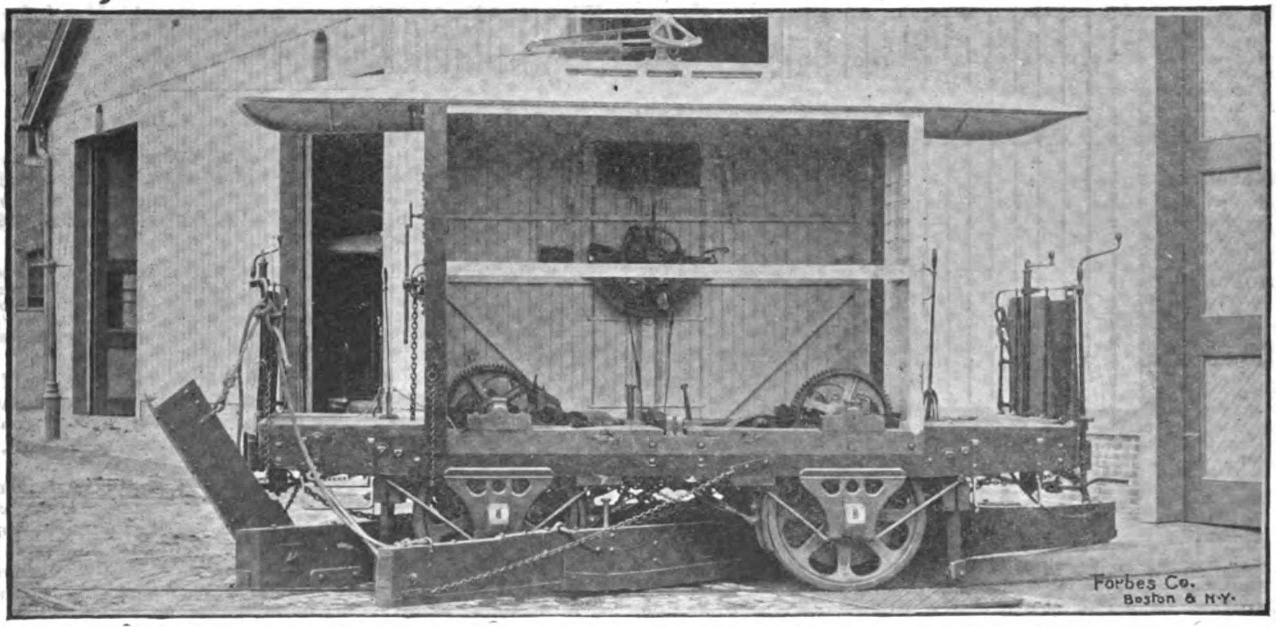
The E. P. Gleason Mfg. Co., of 181 to 189 Mercer street, New York, who are constantly adding to their already large assortment of appliances for electric lighting, are now introducing the new styles of silvered reflectors shown in the accompanying engravings. These are made in shapes of the staple electric shades, radial fluted and spiral corrugated, richly silvered inside, enameled green outside, and greatly increase the illuminating power of electric lamps. The reflectors, the company claim, are always bright, cannot tarnish, are easily cleaned and are very inexpensive. Besides this, they add to the ornamental appearance of the electroliers and fixtures to which they are applied.



Gleason's Standard Silvered Glass Reflectors.

THE TAUNTON ELECTRIC SNOW PLOW.

The Taunton Locomotive Manufacturing Co., of Taunton, Mass., are now building a snow plow for electric railways possessing a number of novel features under the Round patents. The accompanying illustration shows the plow just leaving the car house. It is operated by gear wheels instead of sprockets and chains, which often give trouble, and has a powerful brake which does not interfere with the shears.



The Taunton Electric Snow Plow.

As will be seen, the plow has a cab, with bonnets attached. The motors and all the electrical appliances are placed in the cab, with such tools as are needed. The cab is well lighted, so that the motors and all electrical apparatus can be seen at any time. There is also a light under each bonnet which lights up the track. Diggers are provided for clearing the ice and snow off the track, which can be pressed down with a lever, giving the wheel a good contact. The shears have shoes where they bear on the rails, thus preventing wear and also holding up the ends. These shoes are readily replaced when worn out, at slight expense. The motors are easily removed, and can then be used for summer work.

The plow is simple in construction, and all parts, such as shears and diggers, can be readily replaced. It is double ended, running either way without turning, plows a furrow nearly ten feet wide and requires but three men to run it,—one motor man, one man to attend to the diggers and shears, and one on the rear end to look after the trolley. Any style of street railway motor can be used.

THE "REPUBLIC" INCANDESCENT LAMP.

The American Electrical Manufacturing Company, of St. Louis, announces its new "Republic" incandescent lamps at prices to meet all competition. This is a new departure, and a practical business idea. Their well known "American" lamp has achieved such a reputation that the company is not willing to change its quality, or use any lower priced materials in its construction to meet the lower prices now prevailing. They feel a pride in maintaining the "American" which they claim to be the best that is made, and their steady flow of orders is the best evidence that their trade is willing to pay a fair price for a high grade article. In order to be in a position, however, to satisfy all conditions and meet all demands, they are now manufacturing the "Republic" lamp, to the details of which the same careful attention is given, but some materials are used, and some changes made in process of manufacture that reduce the cost. These lamps they guarantee for 600 hours average life, and state they are equal to any other in the market, except their own "American," for which they guarantee 1000 hours average life. The company notified its trade only a few days ago that the "Republic" lamps would be ready for delivery about February 1, and many large orders have already been received. A large increase in their factory capacity has been made to meet the demands for both grades of lamps.

CHICAGO ELECTRIC WIRE CO.'S CABLES.

We have received from the India Rubber Comb Co. of this city two sections of submarine cable made by the Chicago Electric Wire Co., for Government torpedo service. The former company, as agents for the latter, have sold about 84 miles of this cable in two sizes containing one and seven conductors, respectively.

The conductors in the single and seven conductor cables are alike. Each is made of seven strands of No. 22 B. W. G. copper wire having a conductivity of 100 per cent. The insulation, one-quarter of an inch in outside diameter, surrounds this conductor and is made of the best rubber compound obtainable, is guaranteed to have an insulation resistance of 2,000 megohms per mile. The actual resistance, however, under normal temperature is about 5,000 megohms per mile. The insulation is protected against injurious effects of the sea, either from moisture or other troubles common to submarine cables, by a thin covering of lead, less than one thirty-second of an inch thick, weighing one pound to each fifteen feet. This feature is an innovation in submarine cables and has proved a great success as it entirely excludes moisture. The cables from this point are built up, first by a layer of jute well saturated in tar; they are then armored over this layer of jute, the single conductor being armored with ten No. 13 B. W. G. galvanized iron wire, each covered with a layer of tape, and again tarred. The seven conductor cable is made in the same manner except that 16 No. 9 B. W. G. wires compose the armor. The cables are covered with two layers of best Russian hemp closely wound in opposite directions and are treated with a bath of tar which not only protects the galvanized iron wire from the action of salt water but also excludes all moisture from the cables.

In the manufacture of submarine cables for torpedo service there are a great many difficulties to contend with not experienced with ordinary cables used simply for telegraph. The greatest care in their manufacture must be taken as no chances can be taken on the failure of the cable when wanted for actual service in blowing up the war ship of an enemy. Cables, as generally made with rubber insulation, or in fact every other known substance are prone to deteriorate from inaction or storage. They may dry up and crack and eventually become useless and on this account the Government has been compelled to store the cables immersed in water in order to protect them from the drying effect of the atmosphere. This has been found to be unsatisfactory, besides being very expensive. The cable above described, however, entirely remedies this troublesome defect, the makers inform us. The thin coating of lead protects the rubber from the atmosphere and not only makes dry storage of cables possible but renders them absolutely impervious to injurious atmospheric effects. The advantage to the Government is not limited to the saving of expense incident to the storing of the cables, but the convenience of having the cables readily accessible in case of an emergency is said by naval officers to be of the greatest importance.

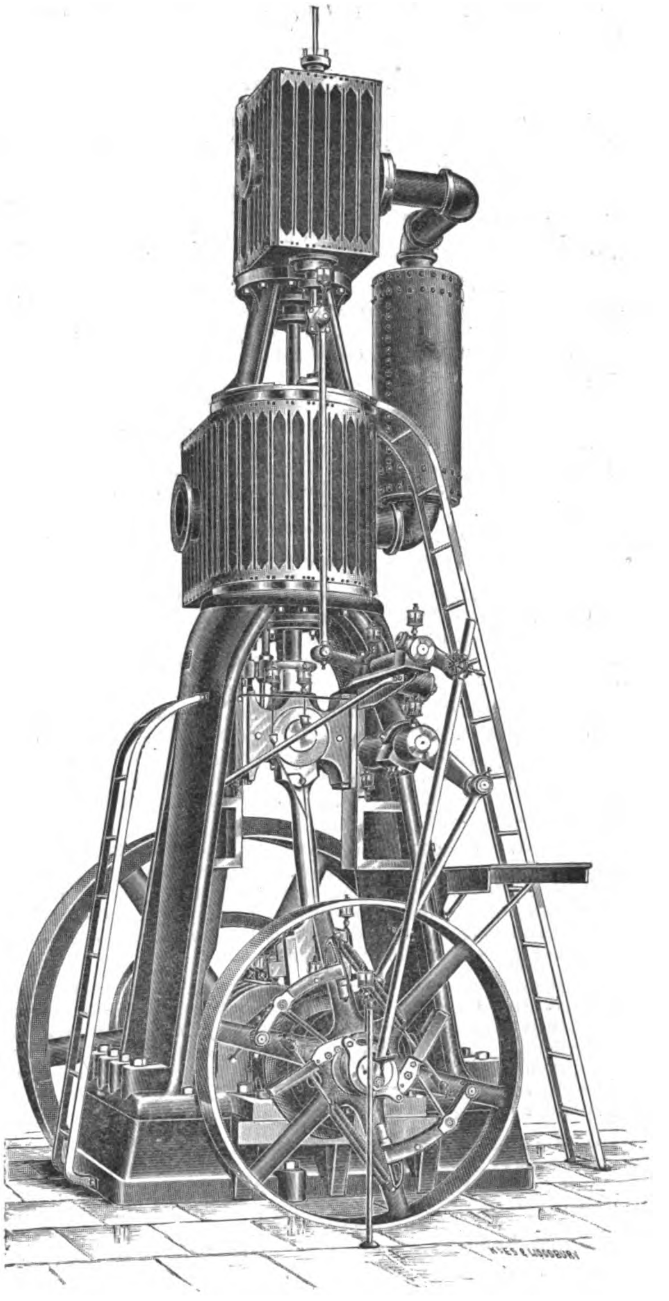
OHIO BRASS CO.

The Ohio Brass Co., of Mansfield, Ohio, has just commenced the sale direct of its electrical street railway specialties. This company has heretofore manufactured this line of goods for some of the largest street railway supply houses in the west; it will, from now on, however, sell its product direct from the factory in Mansfield. In making this change of arrangements, the opportunity is taken to bring out a number of novelties in street railway supplies, overhead material, line devices and car appliances which will interest all electric street railway people.

The officers of the company are, Mr. E. T. Cooke, president; Frank B. Black, secretary and manager. Both of these gentlemen have been interested in manufacturing enterprises for a number of years, and are prominent in business and social circles in Mansfield. The company has secured Mr. C. K. King as its electrical expert. Mr. King is well known in the profession, having for years been connected with the N. W. Thomson-Houston Co. and latterly with the Ansonia Electric Co., of Chicago. Mr. King has had a valuable experience in electric railway construction work both as an expert and as a salesman. A complete catalogue is now being prepared which will be ready for distribution on or about the fifteenth of this month.

THE FITCHBURG VERTICAL COMPOUND "STEEPLE" ENGINE.

The Fitchburg Steam Engine Co. of Fitchburg, Mass., do not intend to be behind in providing for the needs of the public in the steam engine line. The accompanying illustration shows one of two recently built by them for the Oakland Gas Light & Heat Co. of Oakland, Cal., and gives a good idea of its massive strength and graceful proportions. The height of the engine is about 20 feet from top to bottom. The high pressure cylinder is 16 inches in diameter, low pressure 27½ inches, stroke 20 inches, and the revolutions 210. The steam pressure under which it will run is 130 to 140 pounds with which it is expected to easily develop 400 h. p. The engines are connected directly to a heavy line shaft by means of Hill clutches, and the dynamos and motors are belted from this shaft, one engine being at either end of the line so that they can be run together or separately. All the parts of the engine are of the very best material and workmanship, the valves are expansible, as are all the valves used in the engines built by this company, providing for taking up all wear during the life of the engine without expense, while the original economy of the engine is retained. A cast iron lagging planed and polished, covers the cylinders and has nonconducting material beneath it to prevent all radiation.



The Fitchburg Vertical Compound Engine.

The crank shaft is 12 inches in diameter, made of the best forged steel; the bearings are 24 inches long, and the crank is carefully counter balanced for centrifugal force and the weight of the reciprocating parts. The guides are bored and the gibs are adjustable for all wear. The high pressure cylinder has direct connection with the automatic cut off, giving complete control of the engine and a possibility of cutting off as late as ¾ stroke. The low pressure valve motion is driven from an adjustable eccentric attached to the back of the governor case. The engines are absolute in regulation of speed, are of the closest economy in use of fuel and give a very large power in a very small space. A steam jacketed receiver between the two cylinders reheats the exhaust from the high pressure, giving it a slight superheat as it enters the low pressure, the receiver being also jacketed with an outside covering to prevent radiation. Deane independent condensers are used with the engines. These engines permit either direct connection to the line shaft or to the armature of a dynamo, or can be belted to the dynamos or shafting.

NEW YORK NOTES.

Buffalo, N. Y.—There is some discussion of a small preliminary municipal lighting plant for Buffalo, but the existing contracts run until 1897.

The Palermo Mica Co., S. T. Peckham, sales manager, 27 Peck Slip, have issued a neat circular of their mica for electrical purposes, in the various sizes and kinds of New Hampshire mica and "Silver Amber" sheet mica.

The Electrical Construction & Supply Company, of Buffalo, are introducing the American cycle compound for lubricating the chains of bicycles. It is claimed to reduce friction greatly, prevent wear and rusting and make the chain bearings waterproof.

The Springville Waterworks Co. of Springville, N. Y., have secured a franchise for electric lighting, and have already purchased an alternator of the Fort Wayne Electric Co. of Fort Wayne, Ind. The Fort Wayne Company have also secured from the city of Batavia a contract for 120 arc lights of the celebrated "Wood" system.

NEW ENGLAND NOTES.

The Hart & Hegeman Manufacturing Company, of Hartford, Conn., are working ten hours a day with a full complement of men, and are still behind hand on orders. They have not yet had a dull day this winter, a most extraordinary state of affairs considering the times.

The Eddy Electric Manufacturing Co. of Windsor, Conn., have recently received some very warm testimonials relating to their new power generators, and are well pleased at their success in this line. Meantime they are working with a reduced force, but orders are picking up every day, and they expect soon to be in full blast again.

The Brown Electric Company of Boston, have secured the exclusive agency for New England, for the well known specialties in sockets, switches, etc., manufactured by the Iona Manufacturing Company of Boston. The Brown Company are doing a large business also in electric railroad specialties, and have a number of contracts at present under consideration.

I. S. Spencer's Sons, at Guilford, Conn. have an extremely well appointed foundry for turning out iron and brass castings for electrical use, and have been fairly busy during all the months of depression. They make a specially fine casting for small articles, the outsides being as smooth as glass. All electrical manufacturing companies requiring castings would do well to correspond with them.

The Grosvenor-Dale Co., Grosvenor-Dale, Conn., are building their new coal sheds of iron. The construction is designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn., and is so arranged that the coal can be unloaded direct from the cars into the pockets without handling. It is expected to save a large amount of money each year by abolishing the expense of handling their coal the second time.

Mr. Robert C. Wiggin, of Boston, has resigned his position as manager of the motor department of the General Electric Company, and has taken the agency of the Siemens-Halske Company of Chicago for New England. In addition to this, Mr. Wiggin will carry all the specialties of Mr. Charles D. Shain of New York, such as Weston instruments, Carpenter rheostats, etc., and will act in a general way as Mr. Shain's representative in New England. Mr. Wiggin has taken offices at 31 Milk street, Boston, where he will be very glad to see his numerous friends, and introduce them to his new apparatus.

Currier, Mayo & Company, of Boston, have succeeded to the business of J. A. Grant and Company, the well known agents of the McIntosh, Seymour and Company of Auburn, N. Y. Mr. Currier, who has for some years been associated with Mr. Grant, in the firm of J. A. Grant and Company, and is very favorably known in New England, will assume the active management, and Mr. Grant, though still interested in the company, will be relieved so as to attend to his many other business affairs. The capital of the old company remains the same, and they will retain the same offices at 16 Oliver street, and handle precisely the same specialties.

The Perkins Electric Switch Company of Hartford, Conn. promise soon to have a new line of switches, which they feel confident will meet with instant approval. Meantime they are busy with their regular specialties in sockets, switches, etc.

The Day-Moberg Electric Company of Boston, have recently put on the market a new form of storage battery which they call the "Jupiter." It is not at present intended for heavy work, such as street railway, or house lighting, but is well adapted for phonograph, dentists' and physicians' use, cautery, electro-plating, bank vaults, watchmens' and conductors' lanterns, photographers' dark rooms, small motors, and a host of other uses. It is portable in form, will stand a great deal of rough handling, and is constructed specially for the use of people who do not understand the care of batteries. It is intended for use at all times, is always ready, will not get out of order, and will stand an immense amount of wear and tear. For its own field, it is the best thing in the market, and is the design of Mr. Moberg, who has spent years in developing a battery of real practical use. Mr. Day, the business man of the company, will be glad to show the battery to any one interested and will mail full particulars on application.

WESTERN NOTES.

Grand Rapids, Mich. The street railway company at Grand Rapids has decided to build its own electrical apparatus, and is buying machinery, etc., for the purpose.

The Electric Storage Equipment Co. has been incorporated in Chicago with a capital stock of $250,000, to manufacture electric storage batteries under the Fenton and Elliot patents which the incorporators, R. W. Applegate, O. R. Stratton and H. B. Lindley, have purchased from the original holders.

The General Electric Company has secured commodious offices on the tenth floor of the Monadnock Block, Chicago, where all Chicago business will be transacted. The old offices on Adams street will be given up and all the officials will hereafter be quartered in the Monadnock. The new rooms are now undergoing subdivision to adapt them to the needs of their new tenants.

The Electric Appliance Company have been keeping a large extra force busy for the past few weeks taking care of the large shipments which are being received and placed in stock in preparation for spring business. The Appliance Company are materially increasing their storage and shipping facilities and when the alterations are complete their arrangements for promptly handling large orders will be perfect.

The Walker Mfg. Co., of Cleveland, O., has taken spacious quarters on the sixteenth floor of the Monadnock Block, Chicago, at the Van Buren street end. This office will be in charge of Mr. H. L. Barclay, who will look after the western interests of the Walker Company's new business in the manufacture and sale of electric railway motors. Mr. Barclay's office will be open for an active campaign in a week or ten days.

The Star Electric Lamp Company, Chicago, manufacturers of the Sunbeam lamp have changed their name to the Sunbeam Lamp Manufacturing Company. The policy of this company is to furnish lamps superior in quality. Recently some discoveries have been made, as the result of the extensive experiments they have carried on, which they claim will greatly improve the quality and add to the value of their lamp.

The Chicago Electric Truck Co. has opened an office at 1,436 Monadnock Block where Mr. Geo. H. Graham the inventor of the truck to be exploited and the vice-president of the company is in charge. The company has just been incorporated under the laws of Illinois with a capital stock of $25,000. Mr. Graham's truck is designed especially for electric street car service and possesses, it is claimed, many advantages for that class of service.

CANADIAN NOTES.

The Packard Lamp Co., Ltd., of Montreal.—The "Packard" high grade incandescent lamp manufactured by this company is meeting with great success and is making a name for itself abroad as well as in Canada as appears by several orders recently received for export, among which was one for 10,000 lamps for Brazil.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. FEBRUARY 14, 1894. No. 302.

EFFECT OF FREQUENCY IN INDUCTION MOTORS.

BY

William Stanley, Jr.

We have lately been informed that, all things considered, a low frequency—as low as 25 per second—"is the proper thing" for the "transmission of power by alternate currents." In this paper the writer discusses some of the points why, from the alternate current motor side of the question, the use of very low frequencies is not justified, and in a subsequent paper he intends to show why such a procedure is bad engineering from the transformer standpoint.

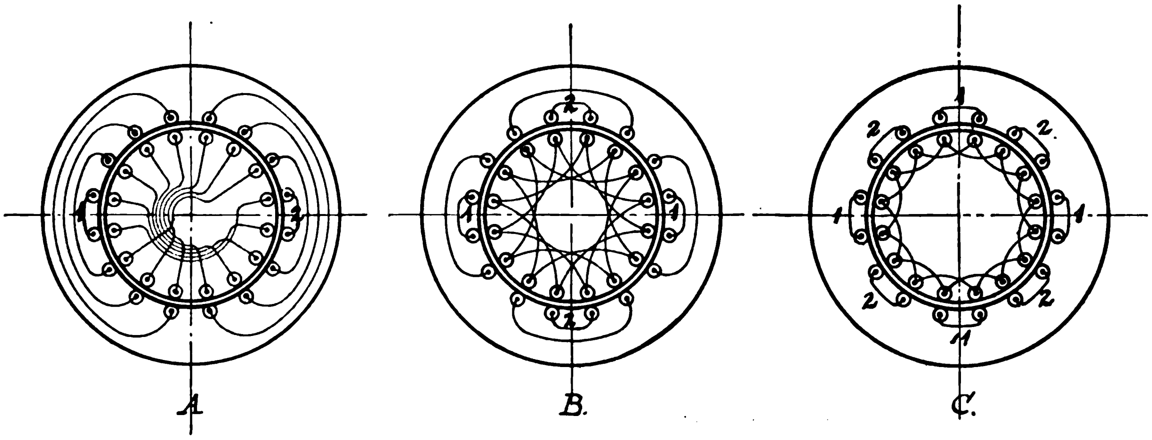


FIG. 1.

In the accompanying diagrams, Fig. 1, A, B and C are illustrated three induction motors connected for frequencies $n = 1$, $n = 2$, $n = 4$; say, 33, 66 and 132 periods per second. The cores of these motors are supposed to be exactly alike, to have the same number of slots and wires in the primary or field rings and similar armatures. The primary wires of A are grouped to produce two poles at 1 and 2, the secondary or armature circuit being connected as diameters. The primary wires of B are grouped in four sets producing four poles (two magnetic circuits) and the secondary or armature conductors are connected at points 90 degrees apart, as shown. The primaries of C are grouped to produce eight (8) poles and the secondaries are similarly arranged.

I propose to show that although the number of wires, speeds and fluxes in the three motors are the same, yet the starting torques and outputs of the motors are not the same, as would appear at first sight, but are greater in B than in A, and greater in C than in B, and that the use of induction motors on alternate circuits gives us no excuse for decreasing the frequency of a motor plant below the frequency best adapted to other interests.

To begin with, let us look at the constant and variable quantities delivering the torque and work developed by a motor, and then consider the relation of these quantities in the torque and work equations in the cases assumed. The quantities having assumed constant value in the three cases are :—

CONSTANT QUANTITIES.		VARIABLE QUANTITIES.
Impressed E. M. F.	same value for three cases.	R of field and armature circuits. C < B and B < A, the value of L (coef. of induction) varies $L_A = 4L_B$ and $L_B = 4L_C$; that is to say, in the three cases the coef. L for primary and secondary circuits varies inversely as the square of the frequency.
Rotational speeds (synchronous)	" " "	
Fluxes entering armature	" " "	
Number of field wires	" " "	
" " armature wires	" " "	

From these data we see that notwithstanding the fact that we have doubled the frequency of Case A in Case B, and doubled the frequency applied in Case C above Case B, yet by increasing the *number of magnetic circuits* proportionately to the increase of applied frequency in order to keep the speed of the motor the same for the three cases, we have actually reduced the self-induction factor opposing the flow of current in the motor circuit. In order to clearly appreciate the importance of these variable values of L and R and their relation to the output of an alternate current motor, let us express the work done by a motor armature in terms of the primary current, frequency, armature resistance and armature self-induction.

Let A = Maximum value of the primary current.
ρ = Resistance of the armature conductors.
M = Coeff. of mutual induction.
L = Coeff. of self-induction of the armature.
n = Impressed frequency.
n_1 = Armature frequency.
$\omega = 2\,\pi n$.
$\omega_1 = 2\,\pi n_1$ and $\omega - \omega_1$ = armature slip = ω_2.
ω_2 = slip.

$$\text{Work} = \frac{\omega_1\,\omega_2\,\rho\,M^2\,A^2}{\rho^2 + \omega_2^{\,2}\,L^2}.$$

A little examination of this formula will show that for any given ratio between ω_1 and ω_2, the work will be greater, the higher the value of ω. This is assuming M to be constant. It is actually, however, a variable depending on the armature reaction. This latter, of course, is measured by the number of armature ampere-turns multiplied by the sine of the angle of lag,

$$\frac{\omega_2 L}{\sqrt{\rho^2 + \omega_2^2 L^2}}.$$

That is to say, the doubling of the frequency applied to the motor in the case assumed reduces the self-induction E. M. F. in the armature to $\frac{l}{2}$ its original value, and from structural causes decreases somewhat the resistance of the armature. The lag of the armature current at a higher frequency will therefore be *less* than at a lower frequency, and the volume of the current for a given amount of work will consequently be less, as the work done by the armature varies as cos θ.

Now an alternate motor of any number of phases or frequency is nothing more or less than a poor transformer, having a movable secondary circuit. It is a poor transformer because of the consequent pole effect occurring between the primary and secondary circuit. It is impossible to so locate the primary and secondary circuit that the mutual induction shall remain constant. If the armature current lags at all,—as it must, to have the motor work,—the armature current opposes and tends to demagnetize the primary circuit, as there is necessarily an opening between the primary and secondary coils at the air gap of the motor, and as the primary circuit is on one side of the air gap, and the secondary circuit is on the other side, the demagnetizing action af the armature tends to scatter the primary flux driving it sidewise out of the air gap, as shown in Fig. 2.

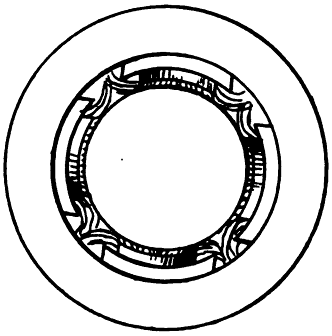


Fig. 2.

This armature reaction is termed "blowing out," and is simply the result of the lagging armature current. The "blowing out" depends on the ampere-turns of the armature and on the lag of the armature current, being maximum when the ampere-turns on the armature equal the ampere-turns on the primary and the armature current lags 90 degrees.

Now in the energizing circuits of A and B, Fig. 1, the ampere-turns per magnetic circuit are the same; but in the armatures A and B the difference is great. The number of turns per magnetic circuit in the armature is but one-half as great in B as in A; the currents in the two armatures are inversely as the cosines of the lag angles, and the demagnetizing effects directly as the sines of those angles. The effective demagnetizing turns vary as $t \frac{\sin\theta}{\cos\theta}$, θ being the angle of lag and t the number of turns per circuit. This is equivalent to saying that the demagnetizing effect varies as $\frac{\omega_2 Lt}{\rho}$, L being but one-quarter ($\frac{1}{4}$) and t one-half ($\frac{1}{2}$) in B what they are in A, while ω_2 is less than twice as great. It is clear that the force acting to lower the mutual induction is practically four times as great in A as in B.

To sum up, then, the virtues of high frequency motors, we have:

First:—A greater torque at all times for the material employed, and, consequently, a greater output.

Second:—A lower impedance armature and a lower inductance in the armature circuit, consequently for a given load a smaller armature current.

Third:—A smaller armature reaction and "blowing out" effect produced by armature reaction.

For what possible reason then have the engineers of the Cataract Construction Company ventured to adopt a frequency of 25 for their motor circuit? Is it because of the volume of the lagging currents at higher frequency? Surely the experience at Pittsfield, where for fifteen months two-phased motors whose magnetizing currents are supplied from condensers have been in operation, is a sufficient proof of the practical operation of condensers. These motors are operating at 130 periods per second. They are connected to all classes of work, operating, as they do, a saw mill, a woolen factory, machine shops, a printing office, etc., and it has been found by actual observations of the voltmeter, in circuit on the consumers' premises, that the variation of potential due to changes of load and lag on the motors does not average 2 per cent. of the voltage applied. The regulation of these circuits is as perfect as if they were simply operating lamps alone.

Prof. Forbes in his paper before the English Institution of Electrical Engineers justified the low frequency adopted at Niagara on the ground of a decrease in hysteretic loss. If he had figured the hysteretic loss per h. p. of output from the motors, and especially if he had taken into account the hysteretic loss in his transformers, he would have found that he would have to pay for the 42 per cent. he intends to save, but even were these figures correct (and we believe they are not), it is 42 per cent. of from 5 per cent. to 10 per cent. in a good motor,—not 42 per cent. of the energy applied to the system, but 42 per cent. of the hysteretic loss. Can the engineers of the Cataract Construction Company give any other reason for thus taking the life out of the alternating currents they intend to employ?

PROF. ROWLAND'S METHOD OF COOLING TRANSFORMERS AND CONDUCTORS.

In order to carry off the heat generated in transformers working under a heavy load Prof. Henry A. Rowland, of Johns Hopkins University, has invented a method employing a current of liquid led through the iron in tubes so placed as not to be cut by the lines of magnetic induction, the tubes and iron laminæ alternating with one another. Water or any other conducting liquid may thus be employed without interfering with the proper working of the transformer.

Another method employed by Prof. Rowland is to surround the transformer with a vessel containing a volatile liquid which, by boiling, carries away the heat. The vapor may be recondensed in the upper part of the vessel or carried off through a condensing coil and returned to the vessel in a liquid state. He also provides means for reducing the pressure in the vessel, in order that the liquid may boil at a low temperature.

To cool conductors carrying heavy currents, Prof. Rowland suggests making them hollow and passing a current of cooling liquid, such as water, through them from end to end, the liquid issuing in the form of spray to break the continuity of the stream and thus insulate it from the vessel into which it flows.

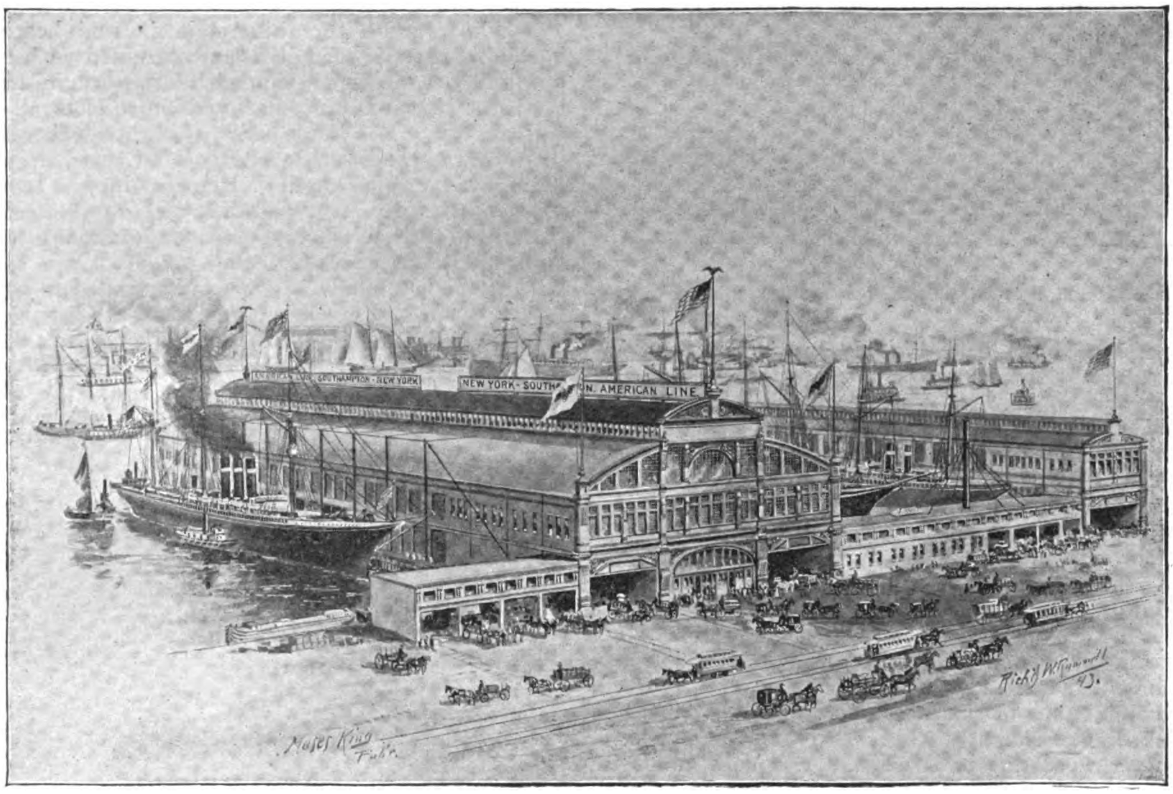
Professor Von Helmholtz has been elected an honorary member of the London Institution of Civil Engineers. The total membership is 6,490, but there are only fifteen honorary members.

THE FINEST PIER IN AMERICA.

ELECTRICAL FEATURES OF THE INTERNATIONAL NAVIGATION COMPANY'S NEW YORK HOME.

I.—THE PIER.

THE International Navigation Company, owning the American and Red Star lines of transatlantic steamers, have nearly completed what is said to be the most perfectly equipped, as well as the largest, pier in the country. Beginning at the North River front on West street, between Dey and Vesey, the pier extends 720 feet into the river and has a uniform width of 125 feet. It is thus only a few minutes' walk from the Barclay street, Park place and Cortlandt street stations of the Ninth and Sixth avenue elevated railroads, and within five minutes' walk of the Broadway cable cars.



THE INTERNATIONAL NAVIGATION CO.'S NEW "AMERICAN LINE" PIER, NEW YORK.

It is also in the immediate vicinity of the New York terminal of the Pennsylvania road, at Cortlandt street ferry; the Central Railroad of New Jersey, the Baltimore and Ohio, the Reading, the Delaware, Lackawanna and Western; the West Shore, the Ontario and Western, the New York, Lake Erie and Western and the Fall River line of boats.

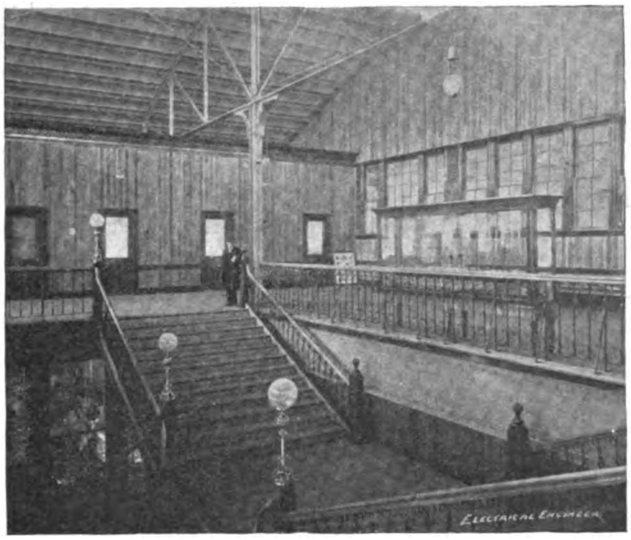
The pier has been leased from the city for ten years at an annual rental of $50,000 and the company has built upon it an enormous two storied "shed," so called—a masterpiece of light but solid iron work—for the convenience of passengers and the handling of freight. The building is the full width of the pier and extends to within 125 feet of the river end. The second floor will be wholly given up to cabin passengers, who will reach it directly from the main decks of the steamers and avoid the nuisance and discomfort of being indiscriminately mixed up with baggage, freight, cabs, trucks, etc. At the eastern end is the grand stairway leading by low, wide steps from the floor below, and a passenger elevator. Here, also, are the waiting rooms and offices, finished in hard natural wood and fitted with all the modern conveniences that one sees in well appointed railway depots. The lower floor, level with the street, is given over to freight, and the offices of the shipping department.

The Commercial Cable Company and the Western Union Telegraph Company have booths on the upper floor, and a public telephone service will also be furnished. The consideration of expense has not been allowed to stand in the way of the very best work in every case, and the whole cost of the building and fixtures has been something over $300,000.

II.—THE POWER PLANT.

In addition to a Sturtevant hot blast apparatus for heating and ventilating the offices, etc., the power plant contains the usual fire pumps, etc. The two boilers are ten feet six inches in diameter and eight feet seven inches long, built entirely of steel. They are of the cylindrical, single ended, return tubular or Scotch type of marine boiler, built by Brown & Miller, of Jersey City. Each has two furnaces with flanged expansion rings and separate combustion chambers. They are so fitted up that they may be run either under natural draft or under a system of induced draught, although under ordinary conditions the natural draught is sufficient to generate all the steam required; still at times, such as on the arrival of ships when an extraordinarily large supply of steam is needed for power and light, the boilers are enabled to give three times their usual power. This system is that of the Ellis & Eaves patent, which has of late been successfully introduced in steamship practice and gives promise of becoming very popular, as it is said to possess many advantages over other systems of forced draught.

The fan used is of a special type built by the B. F. Sturtevant Co. with a direct driven wheel eight feet in diameter discharging into the stack and calculated to give a suction of six inches of water. This fan draws off the waste gases, which, in their transit from the smoke box over to the fan at the back of the boilers, pass longitudinally around sets of three-inch plain tubes thirteen feet long in heater boxes. The ash pit and fire box doors are tightly closed on the furnace fronts, and the fresh air for the fire is drawn through the tubes in the heater boxes, where it is heated to a high temperature, and the amount passing above or below the fire is regulated by butterfly valves in the furnace front. In this manner the waste gases are deprived of considerable heat, and arrive at the fan at a low temperature. When a firedoor is opened, it automatically closes a large butterfly valve in its uptake, thus preventing cold air from being drawn into the fire and preventing the chilling of the furnace and combustion chamber. As there is no suction of air during that time through that particular furnace its supply of hot air ceases. This item alone is of considerable value, as in some forced draught systems the fireman must close all his blast valves before opening a door to prevent the fire being blown into the fire room.



Grand Staircase, International Navigation Co.'s Pier.

Experience has proved that, for any style of forced draught, boiler tubes of small diameter are too apt to become choked, consequently tubes three and one-quarter inch diameter were put in these boilers; plain tubes in one and Serve's patent ribbed tubes in the other. To prevent the too rapid passage of gases through them, retarders, consisting of strips of thin steel, the width of the inside tube diameter, and of the same length as the tube and twisted into a helix of about two turns are introduced into them causing the gases to revolve, and give up more of their heat, and still further increasing the efficiency of the boilers. Retarders for Serve's tubes are the same as for plain tubes, except that they are made narrower to fit between two opposite ribs, and in some cases plugged pipes are also used.

The Serve's patent ribbed tubes are now coming into extensive use, especially in steamship practice, and the company will now be able to make good comparisons with the plain tubes under different conditions. The plant is not quite completed so that there have been no tests as yet, but the patentees of the system have been able to burn as high as 60 pounds of coal per square foot of grate in their boilers at Sheffield, England, thus practically making two boilers do the work of six. As the boilers have ample steam and water capacity and all necessary precautions are taken against priming, etc., the care involved in running them is no greater than under ordinary conditions, the only difference being that the stop valve of the fan is manipulated instead of the ashpit doors.

The designs and plans of the power plant were made under the supervision of Mr. Jas. S. Doran, Superintendent Engineer of the International Navigation Co. and his assistant Mr. George Clarke.

III.—THE STURTEVANT HIGH SPEED ENGINE.

The Sturtevant engine is of entirely new design in every particular; a radical departure from engines previously built by the B. F. Sturtevant Co., and distinctively a high speed engine. Years of experience in the operation of fan blowers which require continuous running at high speed has given this company a thorough appreciation of the requirements of this work, which is so similar in its nature to electric lighting. This particular type of engine was designed primarily for dynamo driving either by belt or direct connection. The features of compactness, accessibility, economy and stability, with consistent lightness of parts, together with the ability to maintain an excessively high speed during a long continued period, are the result of careful study and design.

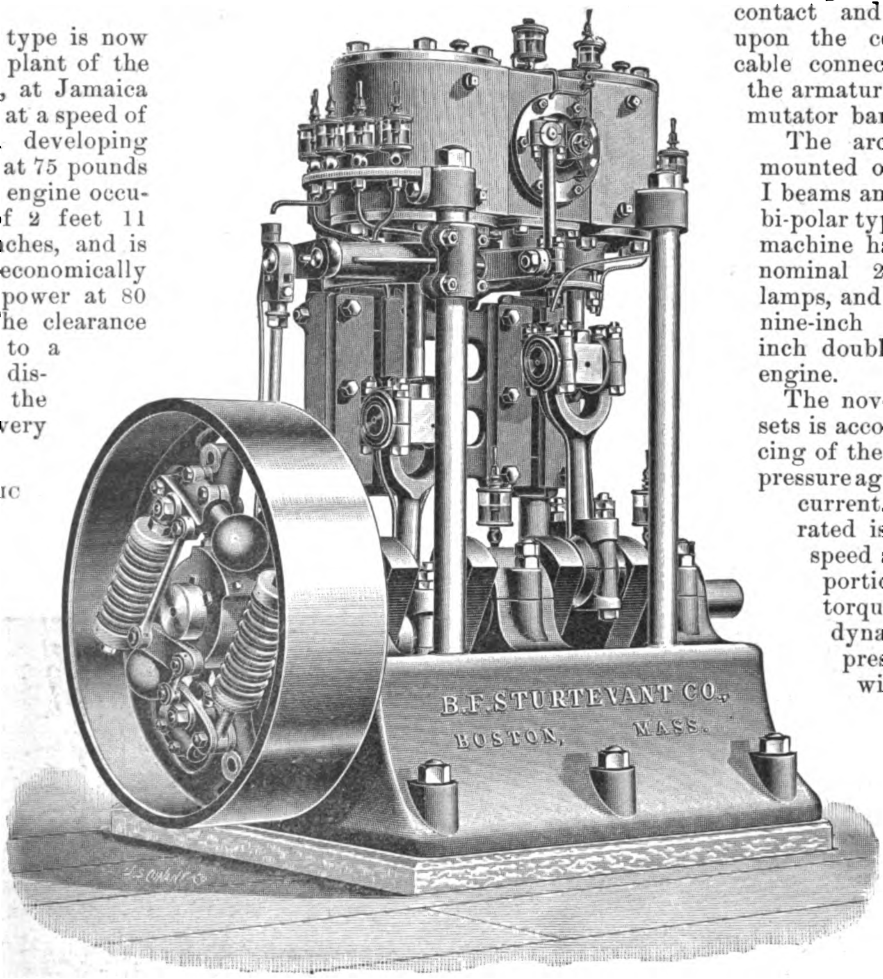
The bed carries the three main journal bearings, brass bushed in their lower halves and provided with continuous oiling devices in connection with oil reservoirs beneath; its interior is formed into a basin which collects all drip from water or oil. The four heavy upright steel columns are securely fastened to this bed and to their upper ends is bolted the cylinder casting. The engine has two cylinders of proportionally large diameter and short stroke, the engine from which this cut was made having cylinders 9 inches in diameter by 5½ inches stroke. The special feature of this engine is a single valve operated to admit steam to the upper end of one cylinder and the lower end of the other at the same time, also attending to the exhaust from the other ends of the two cylinders. This valve is cylindrical in shape with ports parallel to its axis; its ends are extended and form taper bearings, or trunnions, which are carried in special brass taper bushings, abjustable to take up all wear. By this means the valve is always maintained central within its bushing and friction on the valve seat avoided. The entire wear comes upon the trunnions and it is therefore possible to maintain a steam tight valve. The valve simply oscillates, being operated by rocker and rods directly from the eccentric upon the regulator. This

Façade of The International Navigation Co.'s Pier.

regulator is extremely strong, yet sensitive; it controls the admission of steam between zero and ¾ cut off and is capable of the finest adjustment for regulation. A brass dial is provided upon the end of the valve stem whereby the action of the valve is readily shown.

The cross heads are of the slipper type, the cross head pins forming extensions of that part of the cross head into which the piston rod is screwed, and the connecting rods have yoked wrist pin ends and are of large size. The connecting rods and cross heads are of forged steel and all parts of the engine are of the highest grade as regards material and workmanship. Special attention has been paid to the lubrication, separate oil cups being provided for each of the moving parts and all of the oil cups except those upon the main journals being placed upon bars at either end of the engine with tubes dropping oil into catch cups upon the various running parts.

An engine of this type is now driving the electric plant of the B. F. Sturtevant Co., at Jamaica Plain, Mass., running at a speed of 540 revolutions and developing about 65 horse power at 75 pounds steam pressure. This engine occupies a floor space of 2 feet 11 inches by 5 feet 2 inches, and is readily capable of economically developing 75 horse power at 80 pounds of steam. The clearance spaces are reduced to a minimum and the discharge of steam to the cylinders is made very direct.



The New Sturtevant Vertical Engine.

IV.—THE ELECTRIC PLANT.

The electric plant was constructed and installed by The Electro-Dynamic Company of Philadelphia, and consists of two incandescent light, compound wound, direct coupled dynamos, of 400 16 c. p. lamps each, running at a constant speed of 450 revolutions, and two 50 arc light, direct coupled dynamos, the speed of which is governed by the load, running 500 revolutions per minute for full load and proportionately less for lighter loads. All circuits are controlled by switches in the dynamo room. The incandescent switchboard is of slate equipped with one main knife switch and one main ammeter for each dynamo; one combined voltmeter and ground detector, which gives the ground reading directly in ohms; and six double-pole, double-throw knife switches for the different circuits. The switches are all mounted on slate and are so arranged that any circuit can be run on either dynamo. The ammeters and voltmeters deflect on either side of the zero of the scale, and the steel magnets used in their manufacture go through a special process of magnetizing and ageing which gives them a great constancy.

The arc light switchboard is also of slate, and has mounted upon it one ammeter and two lightning arresters for each dynamo, and five sets of plug and socket switches for as many circuits. There are also transfer plugs and socket switches all arranged so that any circuit can be run from either dynamo, and any circuit can be cut in or out without disturbing the sets while running.

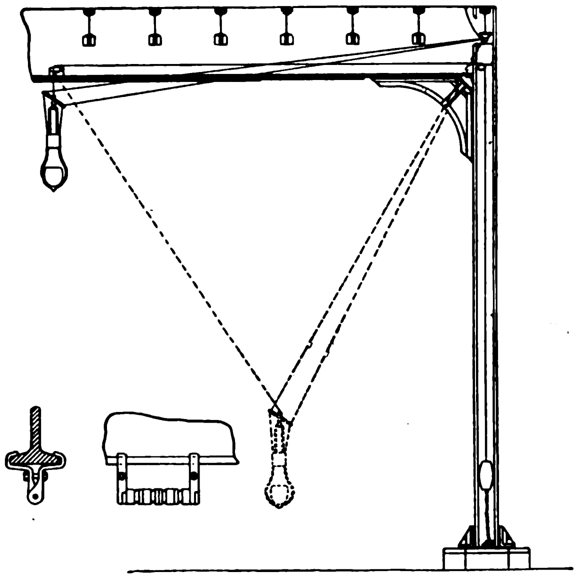
The incandescent machines are of the bi-polar Gramme ring type, compound wound, each with its engine mounted on a common bed plate of I beams and cast cross pieces carefully fitted and snugly riveted together, and directly connected to double upright automatic Sturtevant engines, having cylinders seven inches in diameter by five inch stroke, and running at a speed of 450 revolutions per minute. The dynamos have large ball bearings, bronzed bushed and self-oiling, with a wick feed which delivers to them filtered oil free of grit. The commutator is of tempered copper, mica insulated throughout, with ample wearing surface. Carbon tipped copper brushes are used which give great flexibility of contact and produce little wear upon the commutator. Flexible cable connections are used from the armature winding to the commutator bars.

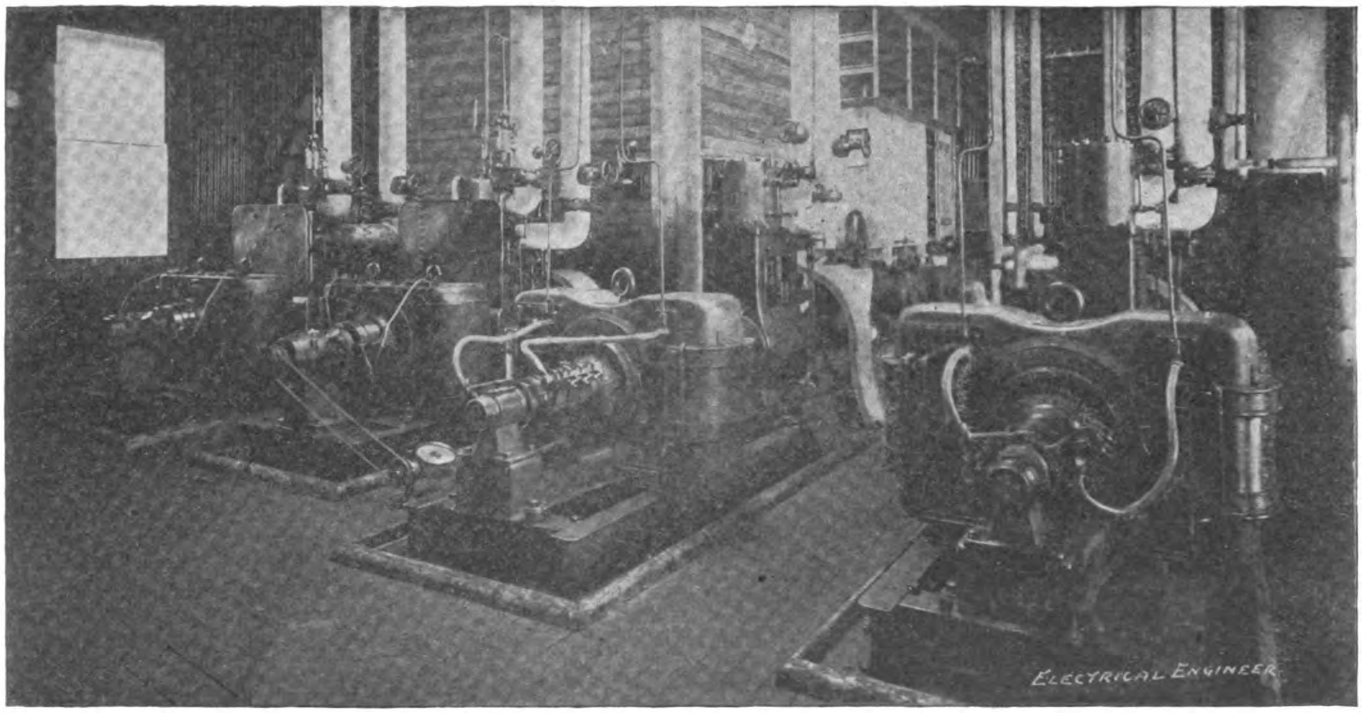
The arc light dynamos are mounted on bed plates made of I beams and are of the Gramme bi-polar type, series wound. Each machine has a capacity of fifty nominal 2,000 c. p. double lamps, and is coupled direct to a nine-inch by five-and-one-half-inch double upright Sturtevant engine.

The novel regulation of these sets is accomplished by a balancing of the torque of the steam pressure against the torque of the current. The E. M. F. generated is proportional to the speed and the current is proportional to the pounds torque of the shaft of the dynamo. A constant steam pressure on the piston with fixed cut-off gives a constant torque on the shaft and constant number of amperes in current. The power used is the product of the pounds of mean effective pressure by the speed, and also the product of the amperes and volts; hence, if the steam pressure is kept constant, the torque in pounds on the shaft and the amperes flowing will be constant and the voltage will vary with the speed. Or, in other words, when more lamps are put in circuit the engines will run faster, and when lamps are cut out, the engine will run slower, which would ordinarily seem paradoxical. With this system, a short circuit will slow the speed of the engine instantly, without damage to any of the parts.

V.—THE WIRING.

In the wiring for the lamps installed on the pier great care has been exercised in the method of thoroughly insulating the wires from the building, and especially in the method of the suspension of the arc lamps. From the polished slate incandescent switchboard in the dynamo room two mains for the incandescent lighting are run to a central distributing board placed in one of the waiting rooms leading from the grand stairway. The sub-feeders are run to three other slate distributing boards placed in various parts of the building, which in turn feed the respective circuits. The lighting is divided up into two circuits, one known as the general lighting circuit, and the other as the police, or all night circuit, both controlled from the main switchboard in the dynamo room. There are also run directly from the switchboard two independent circuits, one on each side of the pier, controlling the twelve cargo outlets for flexible cable to furnish light for the cargo lanterns used in the work of loading and unloading ships at night. Grimshaw white core wire has been used throughout for the incandescent work, while a high grade of fire and weather-proof wire manufactured by the Roeblings has been used for the arc lamp circuit, except that where the wires are connected in loops to the arc lamps on the outside of the building, Grimshaw flexible cable is employed.


METHOD OF HANGING THE ARC LAMPS.



ELECTRO-DYNAMIC CO. LIGHTING PLANT ON THE NEW PIER OF THE INTERNATIONAL NAVIGATION CO., NEW YORK.

The method of lowering the arc lamps on the first floor of the pier is novel. The device consists of two pulleys one fastened on the centre of the web of a cross girder and the other between the flanges on one of the vertical columns supporting the second floor. A steel rope is run from the cross-arm connected to the lamp, and over these pulleys to a balancing weight of such dimensions as to slide easily up and down the column. On the lower end of this weight is a chain so that the lamp can be pulled down and hoisted back into its place. When the lamp is lowered the loop wires draw it towards the foot of the column making a V-shaped angle with the rope suspending the lamp. All lamps are also hung with intermediate insulators so as to thoroughly protect their frames from the iron in the building.

The arc lights on the outside of the building are hung upon iron cranes arranged to swing back against the windows, so that the lamps can be trimmed without being lowered. Those at the two corners of the river front can also be swung around to light the slip if necessary.

The wiring of the pier was carried out by the International Trading and Electric Company, of this city, in accordance with the plans and specifications of the Electro-Dynamo Company, of Philadelphia, and under the supervision of their engineer. It is gratifying to know that the only transatlantic line flying the Stars and Stripes is also the possessor of the finest pier in America, provided with the most modern system of electric lighting.

THE TELEPHONE PATENT SITUATION.—V.

THERE seems to be a prevailing superstition that a non-infringing form of magneto generator, when once secured, may be used in connection with telephone circuits without infringement; it may be so used provided it be permanently connected in series with the telephone instruments. The moment an organization of circuits is employed, however, in which the magneto calling apparatus is in circuit while ringing up, and is out of circuit while conversation is being carried on, a patent of Thomas A. Watson is infringed. This patent is dated April 16, 1878, and is numbered 202,495. The claims are as follows:

> 1. The combination, with a system of electric telephones, and upon the telephonic circuit, of signaling apparatus and a supplemental electric generator in a branch circuit independent of that containing the telephone, the whole being arranged and adapted to call the attention of distant operators, substantially as shown and described.
>
> 2. The combination, with a system of electric telephones, of a supplemental magneto-electric inductor in an independent branch circuit, substantially as shown and described.
>
> 3. The combination, with a system of electric telephones, of magneto-electric inductors and call-bells with polarized armatures, the whole being operated substantially as shown and described.

It will be readily seen that any form of magneto generator which is alternately in circuit and out of circuit, infringes this remarkably broad patent. Private line or other apparatus to be non-infringing must either use a battery call, or must have the magneto permanently in circuit, which would seem to be impracticable.

Another surprise to those who have not made a careful inspection of telephone patents will be to learn that the very idea of a switchboard and even of an ordinary telephone plug is patented. The patent covering these features is that of Charles A. Cheever, No. 208,463 of Oct. 1st, 1878. The claims are as follows:

> 1. In combination with a transmitting-telephone, a receiving telephone, a battery, and a signaling apparatus, a plug-switch having one side of the plug insulated, substantially as and for the purposes described.
>
> 2. The combination of the transmitting-telephones T, switchboard K, annunciator A, battery B, and receiving-telephones R, whereby a less number of receiving-telephones is used to receive messages from a greater number of transmitting-telephones, substantially as described.
>
> 3. The combination of a series of telephones connected with the switchboard K, which is provided with the spring-switches S, and receiving-telephones R and plugs P, when connected with the annunciator A, battery B, and return-wires, substantially as described, whereby the insertion of the plug P cuts out the annunciator and battery from the line through which the signal is to be received, but leaves the other lines intact, substantially as described.

As the growth of the telephone business during the current year will doubtless be more in the direction of private line and speaking-tube service, this patent is not of so great immediate importance as those previously referred to.

Those manufacturers and purchasers of telephone apparatus who propose to use several telephones in series on a line so arranged that a switch to the right or left will afford the desired connection in either direction, will be interested in the claims of the patent of T. B. Doolittle No. 209,115, of Oct. 22, 1878. They are:

> 1. In a district-telephone system, a series of switches, normally constituting portions of the main line, and adapted to sever the main line and complete a circuit from the earth at any station through either fragment of the broken main line on either side of said station, substantially as and for the purposes specified.
>
> 2. A district-telephone switch of conducting material, normally forming a portion of the main line and resting on two conducting-posts of the main line, and adapted to be swung about either of said posts, as centers, into contact with a metallic post having a ground connection, substantially as hereinbefore set forth.
>
> 3. The case I, provided with an alarm-bell and armature, a vibratory bar, and four cross-rods and wire connections, substantially as and for the purposes set forth.
>
> 4. In combination with the vibratory bar P and the cross-bars N N′, the bow-spring R, substantially as and for the purposes set forth.
>
> 5. The lever ends of the bar P, formed as described, in combination with the suspension-hook *f* and latch *g*, arranged to operate in the manner and for the purpose set forth.

It would seem that the judicious use of the metallic circuit would clear this interesting patent.

As to patents upon telephone switchboards and their circuits, a separate series of interminable articles would be necessary to convey any adequate idea of the careful and comprehensive manner in which the American Bell Company, through the Western Electric Company, have covered the subject. Any one contemplating the use of the simplest switchboard for telephone service, is advised to make or have made, a thorough and exhaustive search of switchboard patents before possibly laying himself open to litigation.

To give an idea, however, of how broad some of these patents are, it may be sufficient to refer to the following, covering the multiple switchboard: Patent of Leroy B. Firman, No. 283,334 of Aug. 14, 1883. Claims:

> 1. The combination of telephone-lines L and L^3 with connecting-plates A C, each provided with two plug-bales, the branch circuits, including annunciators 1 and 3, and switching apparatus, as described, whereby either of said annunciators may be included in the circuit of said telephone-lines when connected, as and for the purpose specified.
>
> 2. The combination of the telephone-lines with switches, one for each line upon the central-office switchboard, branch circuits, one branch circuit for each line, each branch including an annunciator and switching apparatus, whereby any two telephone-lines may be connected together through the annunciator of one of the lines, while the annunciator of the other line is not included in the circuit.

In connection with miscellaneous telephone patents, there is one of Thomas A. Watson upon an adjustable desk stand which is of interest.

The date of the patent is Sept. 28, 1880, and the number is 232,787. The first claim is:—

> 1. A telephone stand consisting of a telephone clamp or holder and a standard therefor, the said standard and holder being adjustable as to height and angular position to enable a telephone to be supported at any desired height and angle to suit the user, substantially as described.

It will be observed that if the desk stand be so arranged as to be adjustable as to angular position only, it does not infringe the patent.

One of the most encouraging signs of the times to the private line and speaking tube business, is the sale of telephone receivers outright by the Metropolitan Telephone and Telegraph Company of New York and other like concerns. The Bell company should unquestionably be able to make by far the best telephone receivers, through their ability, acquired by long practice, to produce a compound steel magnet of surpassing strength and durability.

Since January 30th, genuine Bell receivers have been on sale in various parts of the country. No transmitters, of course, or switching devices have been furnished. The price of receivers was first announced as $2.50 each, but it was soon reduced to $1.25 per instrument. The public is distinctly the gainer by the policy of the Bell Company in selling these superior instruments outright, whatever be the motive.

It would seem that the telephone patent situation is full of promise to those who propose to enter the business with a conscientious determination to respect every inventor's rights and to infringe no one's patents. It would also appear that the deliberate infringers are going to have a hard time of it. There are likely to appear two general classes of telephone manufacturers and dealers,—those who do not infringe switch and transmitter patents, or who honestly believe they do not, and those who propose to go ahead to suit themselves, respecting the rights of no one, and depending upon exaggerated and misleading statements to build up a business among innocent purchasers which will be sufficiently remunerative to take care of their own litigation, leaving the purchasers to take care of themselves.

If the new manufacturers of telephone apparatus will only be as careful and as conscientious in respecting existing telephone patents as are the American Bell Telephone Company, and the Western Electric Company, the future of the telephone business in this country will indeed be bright.

One or two vital points, not strictly within the patent purview, will be touched upon in a concluding article.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—VI.

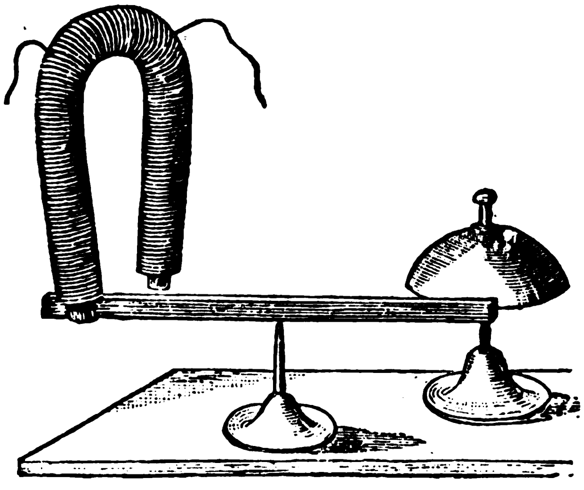
BY

Mary A. Henry

We have seen Henry making that circuit in which electricity was willing to act at a distance and discovering the reason why the great motive force was at last so complaisant after baffling the efforts of man for more than a century; we have seen him making that combination of magnet and battery which in fact constitutes the telegraph. "A number of other experiments," Henry says, "would have been made to verify this had not our use of the room been limited by its being required for public exercises."[1] These were the exercises of the exhibition or Commencement day of the Academy. When that day was over there was quiet in the empty rooms; a vacation of three weeks was before Henry—a delightful, free time to devote to scientific research.

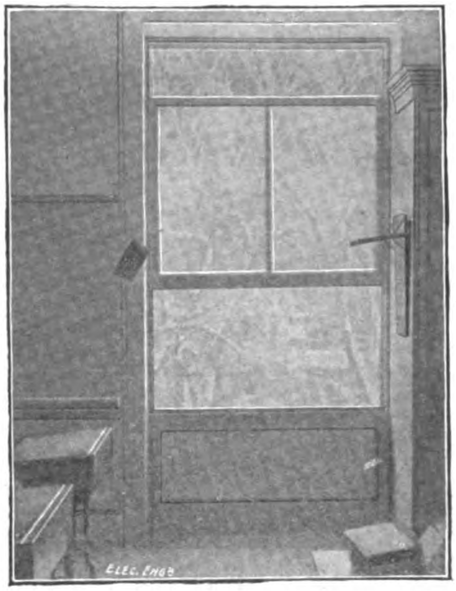
> "At the conclusion of the series of experiments," Henry says, "there were two applications of the electro-magnet in my mind: one the production of a machine to be moved by electro-magnetism, and the other the transmission of or calling into action power at a distance. The first was carried into execution in the construction of the machine described in *Silliman's Journal*, Vol. XX., 1831, and for the purpose of experimenting in regard to the second, I arranged, around one of the upper rooms of the Albany Academy, a wire of more than a mile in length, through which I was enabled to make signals by sounding a bell. The mechanical arrangement for effecting this object was simply a steel bar permanently magnetized, of about ten inches in length, supported on a pivot and placed with its north end between the two arms of a horse-shoe magnet. When the latter was excited by the current, the end of the bar thus placed was attracted by one arm of the horse-shoe and repelled by the other, and was thus caused to move in a horizontal plane and its further extremity to strike a bell suitably adjusted."

Surely it was another marked day in his life when Henry thus put to practical test the power of the circuit he had formed. We go back in imagination to see him make the trial. It is made in an upper room, the room appropriated to his use when he entered the Academy, his school room, lecture room and laboratory. His friend, Dr. Ten Eyck is his assistant. Around the wall passes the wire, a mile long. The battery is the same Cruikshank's trough, we saw him use on that memorable day in the long room.



Henry's Original Telegraph Apparatus.

The "intensity" magnet, if not the same, is of similar construction. In the recess of a window it is placed, and between its arms trembles the small steel magnet upon its pivot, while close at hand is the little bell. The magnet and battery are connected; the electric current begins; the mile of wire does not stop it; the iron horse-shoe wakes to life; the magnetic bar, ready to respond, springs to one pole, to strike with its free end the little bell; the bell rings. The telegraph has given its first signal. The first electro-magnetic telegraph is in existence.



The Starting Point of Henry's Original Telegraph Line.

(As we write these words we seem to hear a protest, and to see a finger pointed to some one or other of those telegraph efforts we have noticed in classes. We answer, perhaps with tedious repetition, those efforts, unable to surmount that great difficulty, the failure of the electric force, were not telegraphs in the sense that common use has given the term; they produced signals by means of electricity, which could be used to communicate intelligence, but they could not make these signals at any great distance. Henry, in the course of a few months had made the sensitive "intensity" magnet, the only intrument which could respond to electric influence at a distance; he had made the combination of magnet and battery, essential to the telegraph, and now, merging the discoverer in the inventor, he had made with that magnet and that combination, by the application of a mechanical contrivance, an apparatus capable of practical work. This telegraph in Henry's room, was not only the first, it was the first possible. It has been said it was not a telegraph, because it was not used commercially. Are our fingers not fingers, because we may not have used them for purposes of trade? This was an actual working telegraph, making sound signals exactly as the telegraph of to-day makes the sounds which give the telegraphic message; and later, in Princeton, Henry used the same arrangement in his philosophical hall to communicate with his wife in his residence, the wires stretching across the college grounds. But all this is a digression.)

Yes, the first telegraph in which there was no danger of the failure of the electric force was in existence. There was only a mile of wire around that room, but with no change in the principles there exhibited; in accordance with the laws there illustrated, that wire was to extend until it connected the Old World with the New, finding not even then a limit to the power of the electric current to act at a distance. We are told that a sound never is lost, that with the new phonetic instruments of the day, the falling stream may give back the words spoken near it, and what we say to-day may be repeated a century hence. There may come a time when history will be read by the ear, instead of the eye; when man may go back to the past, not to search in dusty archives, and among prejudiced records, but to wring from the air each sound that has broken it since it was first breathed by the human race; then this little bell will ring again and tell how and where this telegraph was born—the telegraph which could meet the long cherished desire for distant communication. It had made its first sound; there was its birthplace in that upper room of the Albany Academy, where the holes in the walls, only a few years ago showed where the wires were fastened. Do we say this was the birthplace of the telegraph? We must make here the distinction we have made elsewhere; the ringing of the bell was only one mode of using that combination of magnet and battery, which we have said really constitutes the telegraph. The long exhibition room, where that combination was first made, is the real birth place of the telegraph.

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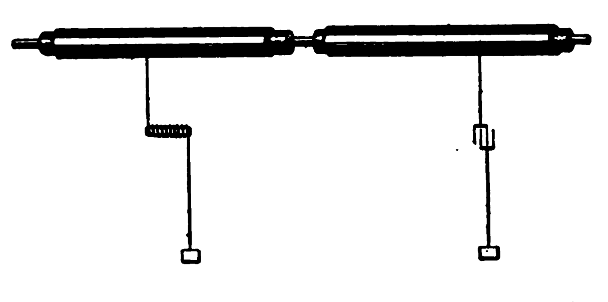
[1] Writings of Joseph Henry, vol. 1, p. 42, or *Silliman's Journal*, Jan. 1831, vol. XIX.

THE TESLA HIGH POTENTIAL CONDUCTOR.

In order to prevent loss by dissipation or interference by induction on line conductors carrying high potential alternating currents they have in some instances, such as at Deptford, London, been insulated and inclosed in a continuous conducting sheathing which is connected with the ground by a good conducting path.

While conducing to the safety of the system, Mr. Tesla has found that the use of a conducting sheath or screen around the line conductors and well grounded, or even brought into proximity to external conductors or large bodies is attended by an actual, and generally a serious, loss of energy which is the greater, the greater the number of alternations and the higher the potential. He therefore maintains the sheath either entirely isolated or connected directly or inductively to the ground, through a path which will practically prevent the passage of currents over it. He has also found that when a continuous isolated sheath or screen is employed, there is greater liability to loss of energy by inductive action; for, unless the sheath or screen be considerably shorter than the current waves passing in the conductor, electromotive forces will be set up between different points in the sheath, which will result in the passage between such points of induced currents. Mr. Tesla therefore, divides up the sheath or screen into short lengths, very much shorter than the wave lengths of the current used, so that the grounding of any one of such lengths or the approach thereto of a large body will result in an inappreciable loss, or at most a small local draining of the energy, while the tendency of currents to flow between different points in the sheath is effectually overcome. The function of the sheath as a static screen for preventing the dissipation of the electric energy, however, requires for its complete effectiveness an uninterrupted conducting partition or screen around the conductor. In the case of a sectional screen, this is obtained, by causing the ends of the insulated divisions or sections to overlap, and interposing insulating material between the overlapping portions.

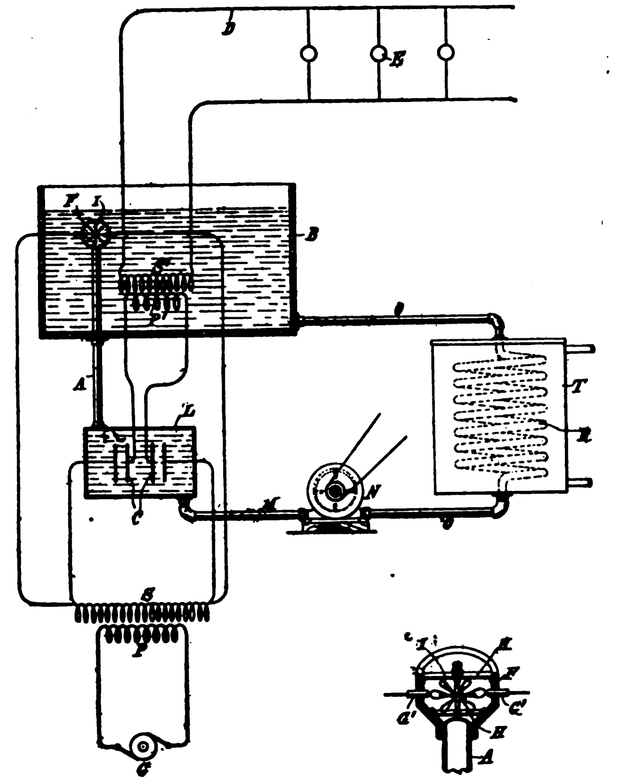


FIGS. 1 AND 2.—THE TESLA HIGH POTENTIAL CONDUCTOR.

For transmitting currents of very high potential and very high frequency, Mr. Tesla provides between the sheath and the ground a path of very high ohmic resistance, or one containing a self-induction coil properly determined with respect to the existing conditions so that it will effect the desired result, or a condenser of very small capacity, as shown in Fig. 1. In such cases the sheathing or screen for practical purposes may be regarded as isolated from the ground, since by the character of the connection employed no appreciable loss results from the passage of current from the sheath to the ground. Fig. 2 shows the construction of an actual conductor of embodying the idea.

TESLA'S AUTOMATIC FLUID INTERRUPTED FOR PRODUCING HIGH FREQUENCY CURRENTS.

The Tesla system of lighting and power transmission with high frequency and high potential currents, as is now well known, involves the maintenance of an intermittent or oscillatory discharge of a condenser or circuit of suitable capacity into a working circuit containing lamps or other devices. In systems of this character when the high frequency of the currents employed is due to the action of a disruptive or intermittent discharge across an air gap or break at some point of the circuit, Mr. Tesla has found it to be of advantage not only to destroy the least tendency to continuity of the arc, but to control the period of its re-establishment, and from investigations made with this object in view he has found that greatly improved results are secured by causing the discharge to take place in and through an insulating liquid, such as oil, and, instead of allowing the terminal points of the break to remain at a uniform distance from each other, to vary the distance by bringing them periodically in actual contact or sufficiently near to establish the discharge and then separating them, or what is the equivalent of this, throwing in and out of the gap or break a conducting bridge at predetermined intervals. To obtain the best results, moreover, Mr. Tesla finds it essential to maintain at the point of discharge a flow of the insulating medium, or, in general, such a circulation of the same as will constantly operate to cut off or break up the discharge as fast as it is established. The accomplishment of this latter result involves the employment of some mechanism for maintaining the flow or circulation of the insulating medium past the points of discharge, and he takes advantage of the presence of the same device to maintain the circulation of the insulating liquid in which the converter for raising the potential and the condenser plates are immersed; by this means the liquid is prevented from heating.



TESLA'S AUTOMATIC FLUID INTERRUPTER.

All this is accomplished by a pumping arrangement shown in Fig. 1, the spark gap being controlled by a small turbine which is shown enlarged in Fig. 2. When the pump is started up and the turbine I revolves, the blades bridge the space between the two terminals, nearly or quite touching the terminals in their movement. If now the tank B be filled with oil and the latter permitted to flow off through the tube A, the turbine will be rotated by the flow, the rate of rotation being dependent upon the rate of flow. By this means the arc or discharge is periodically established through a flow of oil, which secures in the most satisfactory manner the conditions best adapted for practical results. The flow of oil is regulated by the speed at which the pump N is driven, and by this means the period of re-establishment of the arc is controlled. A cooling tank T may be provided if necessary.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - -	per annum, $3.00
Four or more Copies, in Clubs (each) - - - - - -	" 2.50
Great Britain and other Foreign Countries within the Postal Union	" 5.00
Single Copies, - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

Vol. XVII. NEW YORK, FEBRUARY 14, 1894. No. 302.

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TELEGRAPHY AND TELEPHONY IN AMERICA.

Mr. W. H. Preece has recently read before the English Institution of Electrical Engineers a very interesting paper on his trip to this country last year. It is, in a sense, an appendix to his paper of 1884, which in turn took up the thread of a discourse delivered in 1878. In all these papers, Mr. Preece shows himself a keen, intelligent observer, a just critic, and one who is not prepared to condemn something novel simply on the ground that it has the misfortune not to be English. He is ready with hearty praise for what he thought good, and he came evidently to study rather than to scoff. There is of course much in the paper read last month that is familiar to Americans, but it is none the less an admirable epitome of the situation and the status of the electric arts in this country. Mr. Preece observed with care, lost no opportunity of seeing whatever was worthy inspection, and formed his opinions for himself. We may have occasion to refer to other points, but are now concerned chiefly with his remarks on the telegraphic and telephonic fields of work. His close touch with these in England makes his views on what is being done here the most interesting and suggestive part of his paper.

Summed up, Mr. Preece's statements embody an opinion on his part that telegraphy here is practically unprogressive and that telephony is making rapid strides; that England has nothing to learn from America in the use of the key but may gather many useful lessons as to the development of telephony. In fact, we have as much to learn, telegraphically, as the English have to learn telephonically. The inference is that the art of telegraphy here has crystallized, and a further inference, or corollary, would be that this condition was due to the existence of a virtual monopoly that does not keep pace with the times. This again would be a reflection on telegraphic management, but Mr. Preece is too courteous to indulge in that. Besides, may it not be possible that what we have ourselves heard an old expert telegrapher call "Western Union dry rot," is due to the fact that the telegraph has its very practical limitations, and cannot be pushed beyond a certain point? If that be so, the executive staffs of our telegraph companies may be sternly wise in keeping within narrow bounds and doing what they can there.

The telephone is to telegraphy what the incandescent lamp is to the arc light. The key and the arc have a necessarily limited sphere, while the telephone and the incandescent have a range so wide and universal that no frontier has yet been discovered for them. And this is true also of the technical side of the art, explaining why in telegraphy and arc lighting there is such little room for the engineer, while in telephony, as Mr. Preece notes, and in incandescent work, abundant opportunity is afforded for all the very best training and ingenuity that can be found. For this reason, we think, the telephone is even now dominating in the field of transmitting intelligence, and will at no distant date give further evidence of its inevitable mastery.

THE NIAGARA DISCUSSION.

In this issue we bring to a close the discussion on the memorable paper of Prof. Forbes describing the electrical features of the Niagara undertaking and embodying Prof.

Forbes' reply to his critics. Probably no electrical engineering work has ever been so variously criticized as this, and to that extent it is apparent that the authorities still differ widely on essential points in modern forms of electrical distribution. One fact is noteworthy, however, and that is, the almost entire absence of continuous current advocates. Had this paper been read five years ago it is safe to say that the greater part of the discussion would have been based upon the relative advantages of the continuous as against the alternating. As it is, the criticisms are confined almost exclusively to the question of periodicity and its effects and to details of construction. For the present, therefore, and until something more available is brought to the front, it may be considered that for great or even moderately long, distances, the alternating current is to be looked upon as the standard method. Notwithstanding the adverse comments of some of his critics, Prof. Forbes maintains the correctness of the views which led to the adoption of the system to be installed at Niagara and is willing to abide by the results of actual performance of the plant when finished. As a very few months will see the first dynamos at work it is but fair to suspend judgment until that period has arrived.

CONDUIT RAILWAY SYSTEMS.

The prize offered by the Metropolitan Railroad Company of New York, for a practical system for operating street railroad cars by underground electrical conduits has stimulated workers in this field to such an extent that in addition to the many such systems already proposed, we have almost daily brought to our attention some new method designed to fulfill the conditions imposed. It would be folly to deny that the problem is a hard one, but, on the other hand it would be very wide of the truth to say that it cannot be solved. The conditions to be met with are sufficiently well-known, and the question, therefore, resolves itself into providing the most simple means for fulfilling them. Evidently, one of the most important features of such a system, which must be considered, aside from mechanical strength and adaptability, is that of insulation, and those who have had experience with overhead circuits will appreciate the difficulties of maintaining a circuit carrying 500 volts in good working condition underground. If to this be added the further condition that the circuit shall be exposed at frequent intervals so as to make contact with a contact device carried on a passing car, the still greater difficulty of the problem would become apparent.

We have already described various methods which have been tried or proposed for accomplishing the results under discussion, and in this week's issue we publish a description of a system which embodies some features not heretofore used in connection with conduit railways, and which deserve more than passing attention. This system, known as the Munsie-Coles, carries out the principle that the base upon which the insulator is mounted shall be as well insulated as the conductor itself, and in order to carry out this design, use has been made of a particular form of insulator, designed to hold a drying agent, such as sulphuric acid. The practical results obtained with this system during an extended test at Hartford, Conn., would seem to make it well worth the attention of all interested in conduit electric railway work and we shall probably hear more of this system in the future.

EARNING DIVIDENDS.

However much dogmatism may still thrive in matters in which faith or belief alone is involved, it has no place in science or business, and hence we are led to call in question the rather sweeping statement made by Mr. W. N. Stewart in the paper on "Advantages of Direct Connected Direct Current Generators," printed on another page. After showing the benefits to be derived from the method described in the title of his paper, the author boldly asserts his belief "that it is the direct current stations that are paying the dividends." It is a pity that the author was not more specific in his statement, but we may fairly interpret his remark to mean that more dividend paying stations, proportionately, are to be found among the continuous current than among the alternating current stations. As the utterance is based merely on belief, it is perhaps not worth while to enter into an extended discussion upon so slight a foundation but the remark nevertheless is significant as showing the state of opinion, at least in some quarters. But if we examine into the origin of this belief a little closer we may perhaps discover the cause which has induced it. To begin with, it is not so very long ago that the standard method for operating both continuous and alternating current stations was by means of high speed engines belted directly to the dynamos or by slow speed engines and countershaft. While this system is still almost exclusively employed in alternating work, a distinct change has been wrought in the method of continuous current dynamo driving by the quite general introduction of direct connected engines. We do not doubt that by this means considerable economy has been effected in numerous continuous current stations that have heretofore employed belting and that to that extent at least they are in a better position to pay dividends. The "belief" of Mr. Stewart is probably traceable to his success with the more modern method. But we know of many stations of both types that are still employing the old methods that have been, and are still, paying dividends, and until we have more definite figures on the subject the statement of Mr. Stewart above quoted must stand as challenged. If Mr. Stewart's paper shows anything it is, that if alternating stations desire to hold their own with the continuous current they must, like the latter, come to direct connected driving. A beginning has already been made in this direction, and it is to be hoped that we shall see more such machines like the one installed at the Narragansett Electric Light Co.'s plant in Providence.

A Sign of The Times.

The trouble with the electrical business lately has been that there are too many receivers and not enough "transmitters;" but we see marked evidences of a return to normal and healthy conditions of activity. It is true that a great many electrical concerns have been treading the way of sorrow these many months, but trade is certainly on the mend, slow as the improvement may be. It affords us no little pleasure to note as one of the best signs of the time the recent reorganization of the Mather Company which was one of the first to feel the pressure of the common adversity and which is now one of the first to pull itself together for renewed work. It has enlisted capital and brains, and starts out on a new career with many a fervent wish for its prosperity. The courage and enterprise it has shown in springing to its feet again are most commendable and significant.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE MUNSIE-COLES CONDUIT RAILWAY SYSTEM.

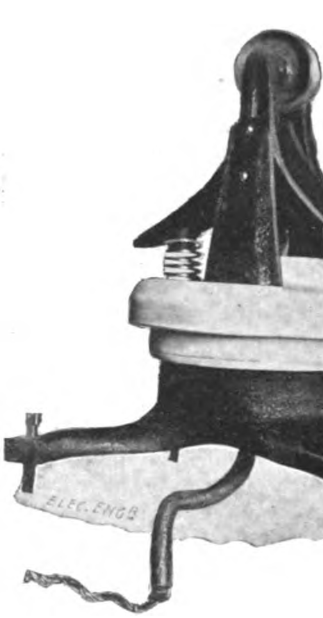


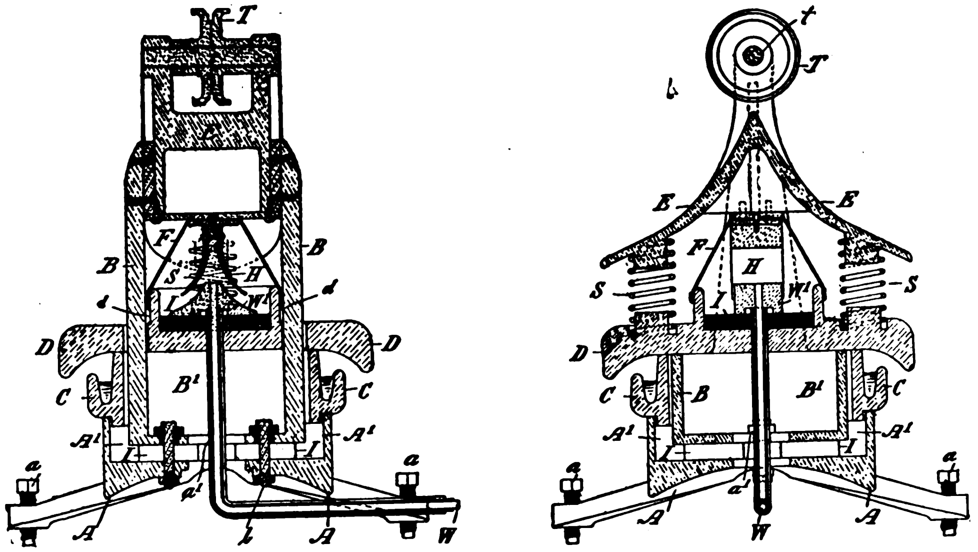
FIG. 1.—THE MUNSIE-COLES RAILWAY CONDUIT INSULATOR.

THE conviction is fast growing in electric railway circles that sooner or later the overhead trolley construction must give way to the conduit system, not only on account of the public demand for the removal of all overhead electrical construction, but because, in the opinion of those competent to judge, in the long run, a reliable underground system will be found to be more satisfactory and economical to operate, than an overhead. But, while this may be perfectly true, electric street railway companies cannot be blamed for exercising due caution and acting conservatively in the adoption of a system which must necessarily involve the expenditure of large sums of money and upon which their very existence depends. As a consequence the system which would seek favor must be shown to be practically operative, or, indeed, have been practically operated under all the conditions to which such a system is subjected. Among the few conduit systems which can be classed under the latter head is the "Munsie-Coles," surface contact system which was operated in Hartford, Conn., and of which an account was given by Mr. A. C. Shaw in THE ELECTRICAL ENGINEER, of May 17, 1893. The work of installation was begun in the fall of 1892 and the car was running in December, and was operated at different times every day except Sundays until September, 1893, without a single case of trouble in the circuit. No drainage was obtainable, as the city would not allow the tearing up and excavating of the streets outside of railroad tracks. The winter offered a severe test, on account of heavy storms of rain and snow with very cold weather. The insulators were often covered with water, slush and mud, but the circuit remained perfect and the car was run every day.

This was purely an experimental plant, but was found a valuable investment, as it enabled the Munsie-Coles Electric Railway Equipment Co. to perfect all their mechanical details of the apparatus and to establish a standard for permanent construction. Those improved details in every case were mechanical constructions on the insulator and surface contact-point box. The working circuit was on one of the railroad's regular lines, and their traffic was maintained without interference while the system was laid and worked. The result of the test was satisfactory in every respect, though performed under the most trying conditions in the Spring of 1893.

The operations at Hartford, though eminently satisfactory, nevertheless gave opportunity for further improvements, and we illustrate in this issue the latest form of insulator employed. This insulator is so constructed that, paradoxical as it may seem, it can be seated in the moist earth, and when the circuit is closed on it with everything covered with moisture, no leakage can take place, although the body of the insulator is made of iron and other metals to insure strength and life.

How these conditions can be fulfilled will be readily seen by a study of the accompanying engraving, Fig. 1, which shows the insulator in perspective, and Figs. 2 and 3, which give respectively a longitudinal and transverse section. A is the iron base hollowed out and running upward to the base of an annular piece of porcelain, C. B is the inner iron which is separated and spaced off from the base by a hard rubber block I and is bolted to it by bolts B B, which are insulated from B by rubber tubing shown as a piece of I. The circular formation of B is broken at the base of the porcelain overhang D, and runs up in two side pieces to the crosshead E, forming guides or slide bars for the crosshead E.



FIGS. 2 AND 3.—THE MUNSIE-COLES RAILWAY CONDUIT INSULATOR.

When the spur wire W is connected to W' on the hard rubber base I, the insulator is turned bottom up and liquid plastic insulation is poured in at A' which fills the space A' made between A and B to the base of C, and then up to the top of D. It also fills up the space B', thereby giving a solid body from the top of D to the bottom of A, at the same time thoroughly insulating B from A.

The efficiency of the plastic insulation is not affected either by contraction or expansion of the iron. After the work of filling the spaces has been done, the friction roller T and spring closer H with its soft rubber hermetic sealing cap F are all attached to the cross-head E. This being done E is connected up to slide up and down between B with F fastened on to the flange D so as to hermetically seal the circuit closer H and the live contact point W' and keep them clear of moisture, etc.

It will be seen by this that when the travelling contact bar on car shown in Fig. 4, mounts the friction roller T, it depresses the crosshead E in slides, which of course brings the circuit closer H in contact with live point W'. It can be readily seen that B with all its metallic contacts will be charged by current but the current cannot charge the base A unless by the outside surface of the porcelain overhang D and C. No moisture can ever lodge between the overhang and the concave space as the trough of the lower insulator C is charged with sulphuric acid which keeps the under part of the overhang bright and dry under every condition of moisture and dampness and consequently makes an absolute insulating brake between B and A. Flooding is not expected to take place, but if it should, water will not affect it any more than to give a slight leak for the time the flood lasts and only at the point where the circuit is closed, as the live point W' is sealed and protected by the cap F. As soon as the car passes the roller T, the spring S of the crosshead, Fig. 2, jumps back into position and makes the break in circuit between H and W'.

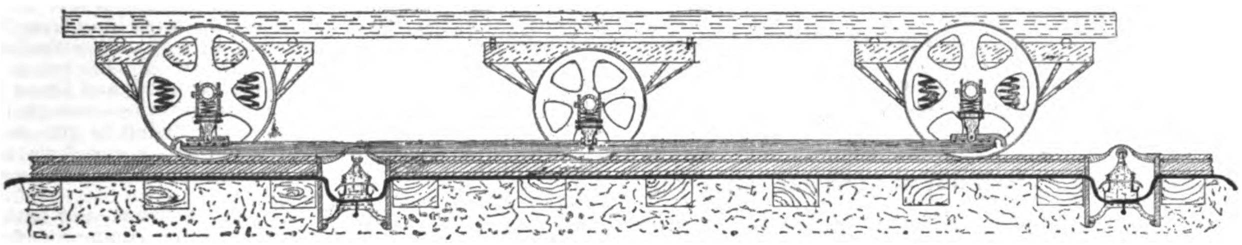
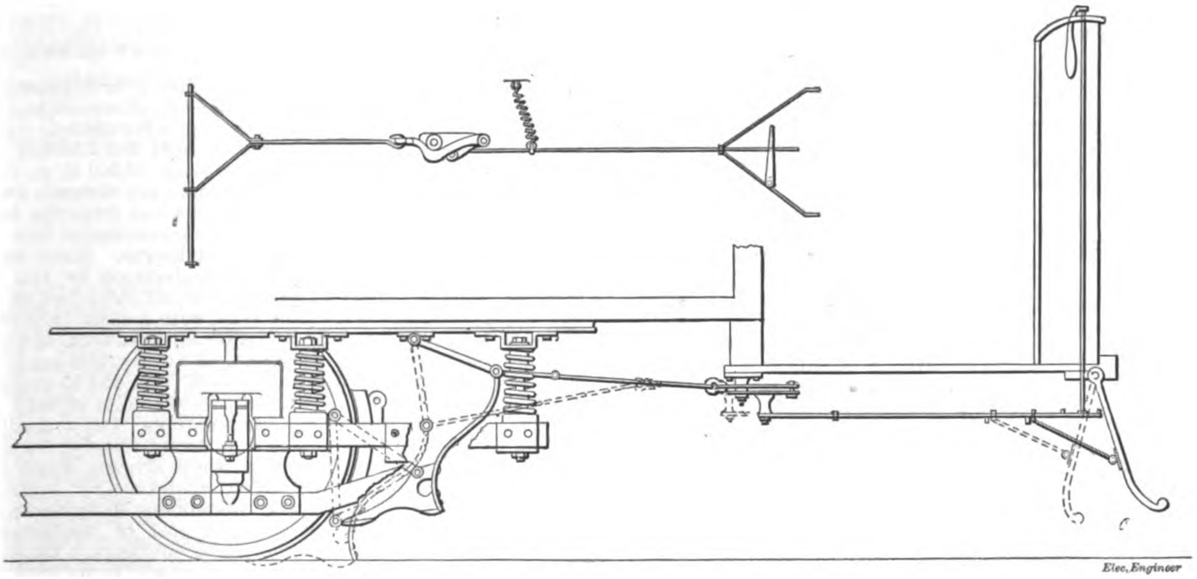


FIG. 4.—THE MUNSIE-COLES CONDUIT ELECTRIC RAILWAY SYSTEM.

The sealing cap F and the annular porcelain chamber C with acid has been shown to be a most powerful practical working insulator, as it did under the severest test substantially everything claimed for it. The crosshead covers the spring S and sealing cap F and protects them from what little water may come through the slot in the surface plate. The corner bolts A are for the purpose of vertical and transverse adjustment of the insulator between bearing rails. The sulphuric acid requires renewing every two or three months, and one man can do two or three miles a day.



Elec. Engineer

AUTOMATIC CAR FENDER AND BRAKE.

It will also be noted that the system permits of the laying of a continuous, highly insulated cable to which the contact boxes are connected by flexible cable tops thoroughly insulated and lead-covered, so that the only exposed portion of the circuit is at the contact points. Another advantage of the system consists in the fact that no slot is required, so that the road way remains uninterrupted. The contact box, as will be seen, Fig 4, projects a short distance above the pavement and the bar attached to the car merely depresses the wheel to which the contact bar is attached and which completes connection between the live underground circuit and the motor on the car. After the car has passed, the contact is broken by the springs and the contact wheels are dead and can be handled with impunity.

The Munsie-Coles system is being exploited by the Munsie-Coles Electric Railway Equipment Co., of this city.

AUTOMATIC CAR FENDER AND BRAKE.

The first step in the improvement of any combination is the elimination of the uncertain human factor. In the improvement of the method of operating cars upon crowded streets so as to avoid accident, the public is not the element to be eliminated, certainly. While the public will benefit by "education" yet many injuries result from a lack of presence of mind on the part of the motorman, and a lack of adequate means of doing what should be done instantly and effectually.

The motorman can be "eliminated" so far as accident is concerned, only by some mechanical device which will automatically and at the proper time do all that the motorman can do,—stop the car. Such a device should cut off the source of power which propels the car, brake the car in the most effective manner and absolutely prevent anything from being crushed beneath the car. It should be simple in construction, always in working order, and inexpensive. All of these various requirements it has been attempted to meet in the device shown in the accompanying cut.

This device is operated automatically by pressure upon the hinged projecting fender, or by the motorman at will. Either method moves the rod under the car-platform, cuts off the current or releases the cable and swings the shoes down upon the track under the wheels, which run up slightly on the shoes, blocking the car. It is evidently impossible for anything to get under the wheels and it is equally evident that the car cannot be more effectually braked, practically, in any other manner, for the heavier the load, the more effective the braking, particularly if the under surface of the shoe is slightly roughened, and for this purpose the shoe may preferably be constructed so that the roughened surface bears upon any desired part of the rail to prevent excessive wear. The shoes on either side of the car may be connected with a light wire fender, to keep anything from getting under the body of the car, or, if preferred, the usual board fender may be fastened directly upon the shoes.

The mechanism at the point directly under the front of the body of the car where the rod running from the hinged fender connects with the rod running to the shoes is a simple lever, for the purpose of obtaining greater movement, and of throwing the weight of the shoes upon a dead centre, it being kept there by a slight spring. This arrangement keeps the shoes in their proper position when raised, offers a ready means for adjustment both as to the movement of parts and delicacy of action, and prevents any operation except in the manner appointed.

The shoes may be lowered, as already stated, or raised by the motorman by means of the lever upon the platform. The handle of this lever is hinged so as to drop into a slot to prevent it being turned accidentally, and this does not interfere with the operation by the hinged fender automatically.

It is not claimed that each distinct part of this device which is controlled by Mr. D. McFarlan Moore, of this city, is new; it was put forth simply as a combination of well known mechanical devices, for the accomplishment of obvious purposes, in an effective and inexpensive manner.

THE BALTIMORE AND WASHINGTON ELECTRIC RAILWAY.

WORK has been begun on the Baltimore and Washington Electric Railway, in which Messrs. P. A. B. Widener and W. L. Elkins, of the Philadelphia Traction Company, are interested. One track will be laid at first and turnouts used while the second track is being put down.

The electric line will be only 32 miles long, while the Baltimore and Ohio's steam road is 40 and that of the Pennsylvania 42 miles in length between the two cities. Entrance has been secured both in Baltimore and Washington, and connection will probably be had in the former city with the Edmondson avenue line of the Traction Company, which is to be converted into an electric railroad.

The estimate of cost of the Boulevard road is $3,000,000. The boulevard is to be 100 feet wide, and about one fourth of that width is to be occupied by the railroad tracks.

CANAL ELECTRICAL PROPULSION IN MARYLAND.

In regard to the use of electricity on canals in Maryland the report of mine inspector McMahan says:

"The use of electricity as a propelling power on the canal has been widely discussed, and from theory has been advanced to practicability. Maryland capitalists and coal operators have recognized the advantages to be derived from its introduction, and a company has been organized with a capital stock of $250,000 to introduce it on the canal. Mr. C. K. Lord, third vice-president of the B. & O. Company, is president of the new corporation, and in its directory are Lloyd Lowndes, H. Crawford Black, Alexander Shaw and J. Clarence Lane. This new method of transportation will greatly increase the output of coal from George's Creek region and will call for the employment of many more miners in our State. Not only will the mining region be benefited, but new life will be given to the towns and industries along the canal by opening up a new field of employment.

WESTERN ELECTRIC RAILWAY NOTES.

RICHMOND, IND. The electric railway line at Richmond, Ind., has passed into the hands of a receiver, who was appointed at the instance of the Union Trust Co. of St. Louis, Mo. The heavy expense recently incurred for improvements and the general depression of business are assigned as causes of the failure. About one year ago this line passed into the possession of Col. John F. Miller, superintendent of the Pennsylvania lines west of Pittsburg, and Russell Harrison, son of ex-President Harrison. The road is 11 miles long and has an equipment of 24 cars, of which 14 are motor cars.

AN INTERESTING FIGHT over the street railway franchise is going on in Indianapolis. The Citizens' Street Railway Company operates all the Indianapolis lines, 35 miles out of a total of 85 being equipped electrically. On January 18 the company's 30 year franchise, it is alleged, expired by limitation. Several months ago the city council prepared another 30-year franchise and sold it to the highest bidder. The old company did not bid for the new franchise, claiming that by virtue of an amended ordinance passed in 1880, but never formally accepted, the old franchise has yet seven years to run. Mayor Denny has called a council meeting to determine what to do. He says the Citizens' company will be notified to vacate the streets. The capital stock of the company is $1,500,000 and less than a year ago the property was sold to eastern capitalists at a high figure.

ST. JOSEPH, MO. A new electric railway is to be built this year at St. Joseph, Mich., to be known as the St. Joseph and Lake Shore Electric Railway. The capital stock of the company, just organized, is $75,000 and the officers are: C. P. Wright, president; J. S. Wolfe, vice-president; A. L. Thatcher, treasurer, all of Chicago; and S. C. Rosenberg of St. Joseph, secretary.

CHICAGO. A franchise has been granted to the Cicero and Proviso Street Railway Company, now operating an electric line in the city of Chicago, to lay two tracks on Chicago avenue from Robinson avenue west to Harlem avenue. The road is to be in operation within a year. Electric, horse or cable equipment may be used, but electricity will probably be employed.

THE NEW YORK-PHILADELPHIA ELECTRIC RAILWAY.

THERE now seems to be little doubt that a trolley line connecting New York and Philadelphia will actually be built in the near future. Within the last few weeks arrangements have been made to extend the New Jersey Traction Company's lines from Newark to Elizabeth and thence to Plainfield by way of Westfield avenue, the "county road," running parallel with, and but a stone's throw from the New Jersey Central Railroad, and hence passing through all the smaller towns whose travel has been exclusively controlled by the latter road. From Plainfield the road will probably be extended through Bound Brook and from there to New Brunswick, and thence through Princeton and Lawrenceville to Trenton.

This section will include the smaller towns now entirely dependent upon the Pennsylvania road for communication with each other and with the outer world.

The section of road between Trenton and Philadelphia is under the control of Col. Edward Morrell, of Philadelphia, who first conceived the idea, it is said, in order to provide a feeder for his steamboat line between that city and Bristol. He has purchased the right of way from the Philadelphia and Trenton Turnpike Company and organized two companies to operate the road, north and south of Bristol respectively. The first of these is known as the Bristol Railway Company and the second as the Holmburg Railway Company. It is promised that cars will be running on the road before next winter.

TRANSFERS IN CLEVELAND.

THE CLEVELAND CITY RAILWAY COMPANY, of Cleveland, having been much troubled by the fraudulent use of transfer checks, has adopted a new variety. It is larger than usual and the conductor in issuing it will be required to punch the month, day, hour and minute of issuance, the junction at which it is issued and the direction in which the passenger is going.

PROPOSED ELECTRICAL TRANSMISSION OF POWER IN INDIA.

SOME time ago Mr. Thomas Oddy, electrical engineer, of Rochdale, received instructions to prepare specifications and estimates for the utilization of waste water power for electric lighting and power purposes in Southern India, says the London *Electrical Engineer*. The project was to transmit 12,000 h. p. from some extensive waterfalls to two large towns some distance away. The towns in question are so far apart and away from the falls that it will necessitate a cross-country power transmission line (poles and conductors) being laid, 110 miles in length. Some idea of the magnitude of the scheme will be understood by the following abstract from Mr. Oddy's report: 3,000,000 cubic feet of water per minute is precipitated over the falls, with a clear drop of 200 feet; 12 1,000-h. p. turbines will be required, 12 towers, 10 bridges, 144 alternators, motors and dynamos, of an average capacity of 250 h. p. each; telephonic communication from end to end and at five intermediate stations; 3,300 poles; 24,000 miles of wire made into cables; two large central-station buildings; two transformer stations; 96 transformers of 250 h. p. each; massive switchboards, weirs, flumes, sluices, etc. The whole scheme when completed will cost £350,000. After making allowance for interest on this loan, paying £10,000 as a yearly instalment to decrease loan, paying working expenses, inclusive of cost of maintenance, and depreciation of plant, machinery and buildings, a profit of £7,000 per annum is anticipated. The current will be utilized for power and lighting purposes in cotton mills, corn and rice mills, for domestic purposes, in machine shops, for pumping, working cranes, hoists, mineral-mining and coal-cutting, haulage of canal tug-boats, tramways, and various other purposes. Mr. Oddy is now also engaged on a similar scheme for some public authorities in Southern Russia. This project is for transmission of 5,000 h. p. a distance of 98 miles.

ELECTRICAL GOODS IN WALES.

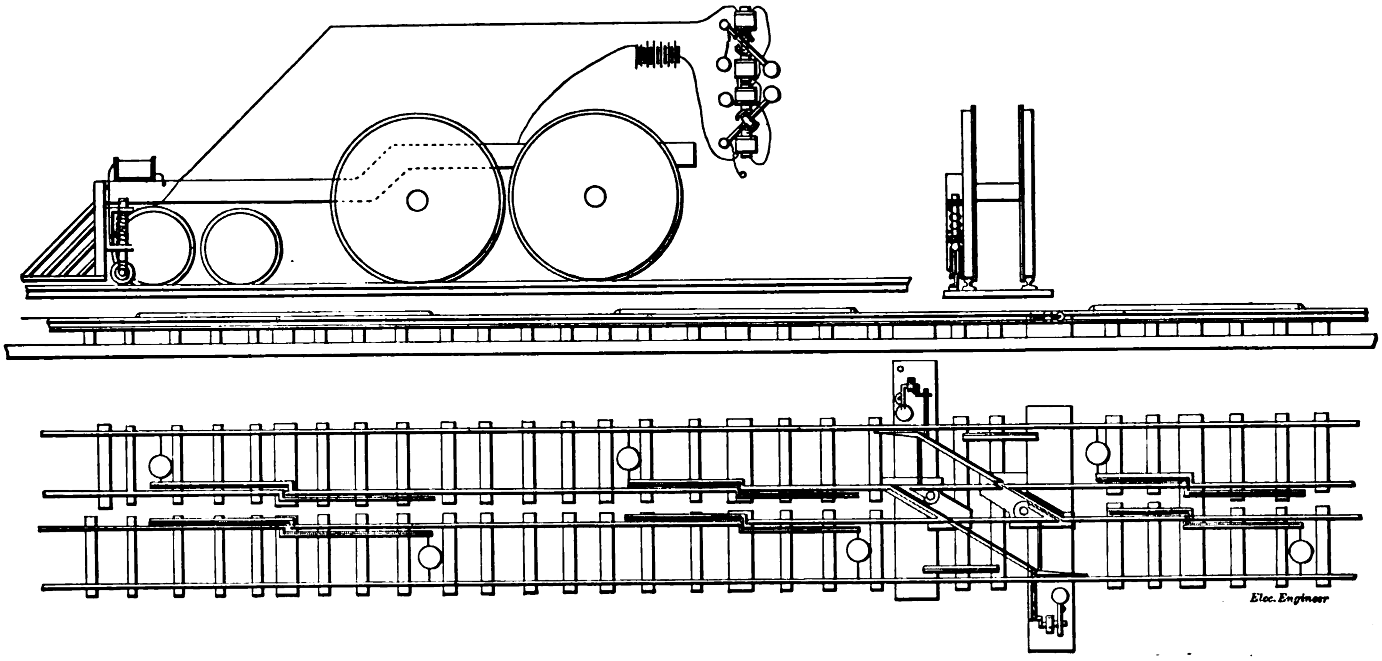
Mr. John J. Willetts, 30 Ryder street, Cardiff, Wales, vice and deputy U. S. Consul, is desirous of securing the agency for American standard electrical apparatus in the Principality.

MISCELLANEOUS.

THE SHEEHY ELECTRIC BLOCK SIGNAL.

Since the recent fatal disaster on the Delaware, Lackawana & Western Railroad the company have been forced to consider some form of block signal system. It seems incredible that a road of this size and importance should have been so long permitted to depend wholly upon the vigilance of its conductors and the sprinting powers of its rear brakemen to prevent rear end collisions; and events now show that beside the loss of life, traceable directly to the lack of modern improvements, the criminal parsimony of the company will result in the loss of a sum of money probably quite sufficent to have avoided the horror had it been expended for some practical block system instead of in the payment of damages.

Among the systems submitted for examination is one devised some years ago by Mr. R. J. Sheehy, of 44 Broad street, this city —an automatic electric signal indicating upon semaphores in the engine cab the condition of the road ahead, whether another another train, a misplaced switch, a broken rail or an open drawbridge prevents further progress or demands caution. The accompanying diagram will explain the system. The tracks are divided into independent blocks, one rail having its sections bonded throughout its entire length, and the other throughout the length of each block and insulated from the next. At the further end of each block the two rails of the track are cross-connected through a permanent resistance embedded in the ground. A contact plate of angle iron a little higher than the track is attached to the other end of the "block" rail (so called here to distinguish it from the continuous rail) and extends back a thousand feet or more into the preceeding block. A similar plate may extend from the forward end into the section ahead, as shown. This when used would be on the opposite side of the rail and is for use in case a train is compelled to back again into a block it has once cleared.



The Sheehy Electric Block Signal System.

On the locomotive is the contact device carried on the frame, but insulated from it and pressed downward by a strong spring, while in the cab are two visual signals and a battery. An artificial resistance is also provided exactly equal to that of the track circuit on any block. It may be mentioned that no matter what the length of any one block may be, the resistances of all are made alike by the coils embedded between the tracks. When the contact arms are resting upon their stops the circuit is, then, from the battery through the semaphores, the resistance and back to the battery, the semaphores both showing safety signals When the contact wheel runs upon the angle iron plate connected with the next block the arm is raised and the circuit is broken at the stops, cutting out the resistance upon the locomotive and instantly substituting that of the track. If the line ahead be clear, therefore, no change will occur in either semaphore. If, however, the circuit ahead should be broken, by reason of a broken rail, a misplaced switch or an open draw, the semaphore indicating "incomplete track" would fall, as it is arranged to do on the cutting out of the current. Should a train be on the block it would short circuit the permanent resistance at the further end and send an excess of current through the instrument actuating the "block occupied" semaphore.

The whole system is thus always before the eyes of the locomotive engineer and neither fog, darkness or smoke can hide his signals from view. The whole system is thoroughly automatic and the cost, both initial and for maintenance, is said to be much lower than that of any existing practical system.

THE ELECTRICAL TRANSMISSION OF POWER FROM NIAGARA FALLS.—IX.—(*Concluded.*)

BY PROF. GEORGE FORBES.

(*Discussion.*)

Prof. Forbes said he had to congratulate them on the fact that that evening's discussion had somewhat redeemed the character of the Institution. Those who had really studied this problem to some extent, who knew what the difficulties were, and where the pitfalls were, must have felt that some of the gentlemen who took part in the discussion on the first night had not even begun to grasp the character of the problem before them. He himself had felt nothing but sorrow for the position of that Institution in having such speeches made on a matter of so much importance. That evening there had been more appreciation shown of the difficulties of the work and of its character generally, and the discussion had been carried on with less show of ignorance. In the discordant views expressed by the various speakers he saw a reflection of the train of reasoning which had been going on in his mind during the years he had devoted to the subject, and he saw the beginning of the workings of the minds of those who would have arrived at different conclusions if they had had longer to think about the matter. He was astonished at the manner in which the question of low frequency had been received. He did not claim for himself one atom of credit for having, after most careful consideration, arrived at the conclusion that the lower the frequency they got in the design of their dynamo the better would it be for the working; but now, after the remarks that had been made, he began to look upon himself almost as if he was the discoverer of low frequency. Before going on to discuss the different speeches, he wished to say a few words on a subject which Mr. Ferranti had brought forward, and which had also been alluded to in the technical press. It had been said that the International Commission was a farce, and that those who prepared schemes had been treated unfairly. Mr. Siemens had in a great measure answered this, and he would not delay them by referring to that part of the subject. But it had been said that it was determined to give to the men who furnished the plans which should be adopted the superintendence of the work. He held in his hands a report which he submitted at the time, in which he said that alternating current was to be used, that it was to be of two phases, that 2,000 volts was to be used for the local work, and that step-up transformers were to be used to carry it to Buffalo, that the motors were to be synchronizing motors, Tesla motors with two phases, and motors with laminated fields and commutators. The International Commission had been absolutely loyal to their compact in giving him the superintendence of this work. The only serious mistake which he made in that report was to recommend the adoption of the Mordey alternators. They knew now that they were not of the right frequency and that in certain other points they would not suit their purpose. If the discussion had been barren in certain parts, they had at least heard from Dr. Fleming of the methods used at Deptford to overcome electrical resonance and that was an important point. The endorsement which Dr. Fleming had given to his views he considered to be of great value, and showed that he given some attention to the subject. When he said that the lines should never be suddenly connected to or disconnected from, the machine, he said something which other speakers probably considered might be regarded as an axiom. But although it might be the practice in this country, it was absolutely the contrary to the practice in America. Accustomed as Mr. Mordey was to deal only with comparatively small electric-lighting plants, he did not realize what their scheme was to be, and especially he did not realize that theirs was to be a power-distributing plant, and that the electric lighting that was to be done was utterly insignificant compared with the rest of the work. Mr. Mordey's opinion that he (Prof. Forbes) had thrown down the gauntlet to electric-lighting men showed that he did not realize the nature of the problem; his reference to transformers of small horse power as being applicable to their case also showed it; his willingness to condemn the artificial load on the ground of expense also showed it. With regard to parallel working, Mr. Mordey argued, if 100 periods succeeded, why go down to 25? He (Prof. Forbes) had shown twenty reasons for going down below that. It was true 100 periods would allow of the machines working in parallel without getting out of step. But they wanted more than that; they wanted them to run in step without waste current passing from one to the other, and without breakdown. He did not consider that 100 periods would succeed so well as Mr. Mordey would lead them to believe. Mr. Mordey knew quite well that while his alternator worked nicely in parallel it did not work perfectly; he knew his machine had broken down at times. They at Niagara could not afford to experience such breakdowns as he had met with in his comparatively small machines. Mr. Mordey's alternator did not work well enough for their purpose. He said, before deciding whether to adopt it or not, tests must be made with high resistance between the dynamos in parallel. Mr. Mordey put in a group of Sunbeam lamps in series. The lamps went up and down with a periodicity of a few seconds. From the moment of those experiments he (Prof. Forbes) felt that the machines were not suitable for their purpose. Mr. Mordey thought artificial loads would introduce greater dangers. He had been utterly unable to see what those dangers were. All he claimed for the artificial load was that it was a help to keep the system from breakdown. They could not afford to have breakdowns. He looked to every possible safeguard that could be devised, even though the expense were something greater. In this case there was no additional expense, because the artificial load when not being used for that purpose was useful for other purposes. Mr. Mordey's remarks about skin resistance would be accurate if they could subdivide the 36 square inches required for the conductors of the first 15,000 H. P. used at 2,000 volts. But they could not get space for the enormous conductors unless they massed them together, and at high frequencies the skin effect would come in. Mr. Mordey's remarks on transformers caused him the most regret, for they showed him how far he was from grasping the problem. He did not appear to realize the work that must be done by consulting engineers. An engineer was very little likely to advise such a scheme until he had every detail worked out to a very large extent. Foreseeing difficulties with manufacturers, he set to work to design transformers of low frequencies for every kind of work for which they wanted them. Designing transformers for special cases and for larger sizes than usual was somewhat laborious work, but the results were quite certain when they knew the quality of iron used. Efficiency was so high as to be of almost no account at all when dealing with the large sizes which they required for their work. With regard to the question of the electromotive force of the dynamos, he really hardly understood Mr. Mordey, who wanted them to use 500 volts. If Mr. Mordey would estimate the section of copper for 50,000 H. P. or so, he would see the difficulties to be met with. That copper section would be about 400 square inches. He had no doubt Mr. Mordey had never realized that until that moment. He could quite understand that with Mr. Mordey's type of machine it would not do to go above 2,000 volts. But he was surprised that Mr. Mordey was not able to realize these two facts: first, that with a 5,000 H. P. the space taken up by insulation was quite immaterial, and in the second place that if you shirked the difficulty of insulating to 20,000 in the fixed armature of the dynamo you would have to face it when you came to the fixed transformer. Mr. Mordey's remarks on lighting were quite beside the mark. Theirs was not a lighting station. Mr. Kapp had dealt with the relative efficiency of single, alternating, two-phase and three-phase currents, and quoted Prof. Elihu Thomson's views. Prof. Elihu Thomson had submitted to him the whole of his reasons for his statement, and he examined them most carefully, and found that they owed their error to the common American mistake of estimating the size of the conductor by the amount of drop they were going to allow instead of by Lord Kelvin's law of economical section. Mr. Kapp admitted his (Prof. Forbes') proof that the losses in the field of a multiphase motor were increased 42 per cent. in the case of a particular motor when they doubled the frequency, but he claimed that a machine with twice the number of poles running at the same speed gave 2¼ times the power. Had it not been Mr. Kapp who said that, he would have taken no notice of it. But in both of them they had the same total number of lines of force rotating with the same velocity round and round the armature, generating the same electromotive force in the armature and the same current. There was no difference whatever in the power developed in those two machines, and the 42 per cent. remained as he (Prof. Forbes) had given it. Mr. Kapp said they could not find space to put rings on to a direct-current motor to convert it into a synchronizing motor, He (Prof. Forbes) did that last summer with one of the stock machines supplied by the Westinghouse Company. Mr. Kapp said he did not know how he would start that motor. The motor would only require to be started once in several months, yet he had started it without recourse to Tesla motors. Mr. Kapp said he had objections to low frequencies with motors, but he did not give his reasons. He heartily thanked Mr. Kapp for the way in which he spoke of his (Prof. Forbes') machine; he was exceedingly glad that a man of such eminence in designing as Mr. Kapp had spoken so well of the machine. He need hardly say that if he dreamt that the Cataract Construction Company were acting in any unfair way he should cease to be connected with the work. Mr. Ferranti had been good enough to tell them that he had stolen the machine from Mr. C. E. L. Brown. Mr. Brown said it was the worst possible design that could have been devised. He knew it was simply a ridiculous assertion that the design of that machine could be said to be in any sense like that of Mr. Brown; but he was glad to be able so promptly to bring a quotation from Mr. Brown to show that he did not think so. He believed his (Prof. Forbes') machine was the first which had been designed upon a principle which ought always to rule the design of a large machine of a new type of construction where they had not past experience to go upon, and that was that they should reach the most economical efficiency. In this design he had added material until he reached a point at which $60 worth of material did not save 1 H. P. He had found, as the result of experience in trying parallel running with different types and a certain number of different frequencies, that lowering the frequency increased the efficiency, and not only the ease, of parallel working. With regard, further, to Mr. Ferranti's remarks, he denied *in toto* that any person had the right to say that the design of that machine had a plausible resemblance to the design of any machine that was put before the Company. He was seeking to get the best design he possibly could, and in so doing it so happened that he differentiated that machine from any one of those sent in infinitely more than they differentiated amongst themselves. Mr. Ferranti said he was wrong in saying that 20,000 volts completely insulated was so very good. He (Mr. Ferranti) thought 10,000 volts with one pole to ground was better. He gave as his reason that with the 20,000 volts, if one conductor was put to ground, the whole insulation was reduced to 10,000 volts. Yet he admitted that he had one of his own conductors to ground; suppose the other got put to ground by any means, how many volts insulation would that be reduced to? It might be that by using concentric cables they avoided the chances very much of putting the other one to ground, but there were connections and numbers of other means by which it could be put to ground far more likely when hidden underground than in the subway. They owed some gratitude also to Mr. Evershed for working out the back electromotive force due to the inductive action of the conductors, and for showing them how valuable low frequency was for that reason. Mr. Crompton complained that he had not given the cost. Mr. Crompton might be perfectly sure that when they knew the actual cost down to a penny he would not give him the cost then either. There were some things he could not tell them, but he did not think the Institution had any right to complain of his not having been candid enough. The result of the discussion upon his mind had been, first, astonishment to find that he was a discoverer instead of a plain, straightforward plodder; and in the next place he was impressed by the vast differences of opinion expressed by different members of the Institution. He felt a good deal fortified in all the conclusions he had arrived at by the general result of the criticisms, however opposed to his views they might have appeared to be. It might be premature for him to say so, but he felt now that all those who had entered into the discussion would, with further study of the subject, ultimately arrive at his position. Meanwhile he thanked them heartily for the expression of their opinions; he appreciated their motives, and he appreciated the value of what had been said by some of them. At the same time he could assure them that he had not lost one particle of confidence in the perfect success of the work that was being carried out; in fact, his own opinions had been strongly confirmed by the general result of the discussion.

The PRESIDENT said although the hour was very late he was certain they would not wish to close that meeting and the session without conveying to Prof. Forbes their deep thanks to him for having brought that subject before them, and for having elicited such an important discussion. They had evidence before them that night of Prof. Forbes's enthusiasm and his nervousness, or rather his suppressed anger every now and then had kept him from that fluent defence of his position of which they were more familiar. He was quite certain that if any one of them had worked for years on a tremendous undertaking like that of Niagara, and had been as severely handled as Prof. Forbes had been, they would not have remained as cool as he had.

ADVANTAGES OF DIRECT CONNECTED DIRECT CURRENT GENERATORS.[1]

BY W. N. STEWART.

For a model generating plant of 500 h. p. the following apparatus should be installed: One multipolar generator of 100 h. p., running at about 250 revolutions per minute, directly connected to a compound engine of the same speed. One multipolar generator of 400 h. p., running at about 170 revolutions per minute, directly connected to a compound engine of the same speed. In most cases condensing apparatus is to be used where water is available. These dynamos are to be made for 220 volts if the 3-wire system is used, and for 480 volts if the 5-wire system is employed; 3 wire distribution to be employed where the distances are not over one mile from the power house, and five-wire where they exceed one mile.

Additional apparatus as follows would be necessary: for 3-wire system, 120 cells of storage battery, each cell having a capacity of 30 amperes for fifteen hours; for 5-wire system, 240 cells of battery, same size. This storage plant to be used as an equalizer and regulator, and to furnish current during the day. Necessary switchboard apparatus, including an automatic regulator for dynamos, would also be necessary.

The wiring would be as follows: one circuit of mains and feeders for commercial and house lighting. This would supply all private consumers with arc or incandescent lighting or motive power; each customer to have a meter. All motors to be connected to the outside wires of either three or five-wire system.

To operate this plant we would employ but two men—one engineer and one fireman. The station would have a superintendent and lamp trimmers as necessary for the number of arc lamps used. The public arc lamps would be wired as follows: if 3-wire system is used, a common neutral wire would be supplied for both public and private lights: this neutral being thoroughly grounded at various points. Thus but two wires would be run for the public lighting; the arc lamps being connected in groups of two between the positive and neutral. If the 5-wire system is used, the arc lamps would be run in groups of eight, each lamp having an automatic cut-out. To run arc lamps on a constant potential circuit it is necessary to have a certain amount of resistance in the circuit to steady the arc; this resistance should be in the line wire, iron wire being used in some cases, or copper wire not smaller than No. 8.

Technical men may say that this is a waste of power, but the author thinks this loss in resistance is overrated.

If the ordinary arc dynamo gives 78 per cent efficiency and the constant potential machine 95 per cent., we have a difference of 17 per cent. in favor of the constant potential machine. The resistance necessary to work the low tension arc lamps never absorbs more than 15 per cent. of the current, so that we have an advantage of 2 per cent. in favor of the system which I am describing.

But we have still another gain: the ordinary arc dynamo runs at about 900 revolutions per minute and must therefore be belted to the engine. The friction of this belting and high speed dynamo must be taken into consideration. If one belt direct from the engine is used, 10 per cent. is lost; if a counter-shaft is used, 18 per cent. is lost. So that is one case where we gain 12 per cent. in our power bill, and in the other 20 per cent. And this is not theory; it is being done every day in the State of Wisconsin, and adjoining states.

The operation of such a station would be as follows: The small dynamo would be started no later than four o'clock in the afternoon, most of its current being absorbed by the storage battery; as darkness approaches, the large dynamo would be started, its current being divided between the customers, streets and storage battery, until all the lights are burning, when the battery would simply act as a regulator. This engine would run steadily until 2 o'clock in the morning, the last four hours being principally devoted to charging the battery. Thus the employees would have a daily run of 10 hours, and the engines would always work at maximum efficiency for the full run. The battery would do the work 14 hours daily. It may be well to state here that storage batteries are now being used in most European stations, and in three or four of the largest American stations with good results, and that batteries can be had which infringe no patents, and which are thoroughly reliable in their action.

We have a station which is made up as follows: One machine in operation at one time, doing all our work, that machine having an efficiency of 95 per cent. with no losses in belting or shafting, running at slow speed with consequent minimum of cost for repairs. A daily run of only 10 hours, thus getting the best possible service from employees. Current available day and night for all persons. A machine which does not burn out, and which can be repaired in three hours. Low pressure wiring, therefore no damage suits for loss of ife. Longer life and less blackening of incandescent lamps, as the battery gives a current absolutely uniform at all times. Less real estate and buildings required. Less liability to breakdowns. No burned-out armatures. The average cost of burned-out armatures on arc machines in 77 cities was last year $2.14 per arc lamp. Less oil; fewer employees; no losses in transformers, or other subsidiary apparatus.

The author asserted that an economy of 40 per cent. could be thus obtained over the old-fashioned methods, and cited several instances of existing plants to substantiate his statement. In conclusion, he said that facts, as observed by him in this country and Europe, lead him to reiterate his belief founded on 23 years' work in the electrical business, that it is the direct current stations which are paying the dividends.

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[1] Abstract of a paper read before the Northwestern Electrical Association, Milwaukee, Jan. 17, 1894.

CORLISS COMPOUND ENGINES FOR ELECTRIC LIGHT WORK.[1]

BY E. L. DEBELL.

WITHOUT attempting comparisons with any other types I will endeavor to give the conclusions arrived at from the use of Corliss engines in our plant at Sheboygan, leaving each of you who is interested to compare them with results or knowledge obtained of the other types. In our plant we have been running steadily for the past 15 months a Corliss cross-compound, 24 x 28 high pressure cylinder, 46 inch diameter low pressure, speed 74 revolutions per minute, rated capacity about 650 h. p.

We use a syphon condenser, supplied by a duplex pump with two 18 inch steam, and two 12 inch water cylinders, 12 inch stroke.

We carry constantly 25 inches of vacuum, which, however, can be readily increased to 28 inches should the load be very heavy. When the load is light we consider it the best practice to keep it at 25 inches and reduce the steam pressure.

A good Corliss engine of this size and type should handle its rated economical load on 18 pounds of water evaporated per horse power hour and within a range of 20 per cent. above or below that point on not over half a pound additional. With good boilers properly fired, and allowing 7½ pounds of water evaporated per pound of coal this would equal 2.4 pounds of coal per horse power hour.

It should be borne in mind at this point that while the first cost is higher for an engine capable of running the least coal, it is really cheaper in the end, as less investment is required for boilers, and the saving in coal continues for all time.

The first cost of the Corliss engine may be placed at one-third more than an equally well made one of the high speed type, and it takes up about one-third more room. Its life however is generally conceded to be 50 per cent. longer, on account of larger wearing surfaces and slow speed. The greater bulk is usually of no serious moment, except where space is restricted or valuable. The cost of attendance and oil and waste is practically the same as on any other good engine, while the cost and facility of making repairs seems to be in their favor.

Another feature of the Corliss engine is that trouble usually develops slowly, in most cases giving warning of its existence in time to apply the proper remedy before it becomes serious, sometimes saving a shut-down of more or less duration.

The selection of proper sizes is a very important consideration as the addition of an extra cylinder reduces the range of economy. The load in nearly every electric light plant is so variable that one engine cannot do the work properly, and it is probable that in most cases three engines of one size will give the best results. They should be large enough so that one will handle the light load, two of them the heavy load, leaving one always in reserve. This gives an economical size for all the varying loads, and practically duplicates the plant with a minimum expenditure in idle machinery. The cost of the three engines will not be very much greater than the same capacity in one or two engines, and some less boiler capacity will be required.

As to close regulation and steady motion, no trouble should be had on this score, if the power machinery is properly installed and managed, and the engines worked within their economical range.

The proper appliances should be used both in the engine and boiler rooms to ascertain if the benefits paid for are being secured, and if not, where the leak is. If more fuel is being consumed than seems necessary, examine the engines, and if they are working properly ascertain how much coal the boilers are consuming per pound of water evaporated. The trouble will most likely be found in one of these quarters, and when remedied good results will surely follow.

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[1] Abstract of a paper read before the Northwestern Electrical Association, January 17, 1894.

SOME PERSONAL REMINISCENCES OF HEINRICH HERTZ.

The first days of the new year have brought with them a mournful message which could only be received with deepest sorrow in all countries where science has found a home and the work of its representatives meets with adequate understanding. Heinrich Hertz, the celebrated physicist, has, after a short but brilliant career, closed his eyes forever, and a life bright with powerful and fertile energy, and unfolding the most splendid prospects, has sunk into an early grave. The grief which the news excited in Germany, his native country, meets with a loud echo in all parts of the world where the weight of the loss is fully understood and the merits of the deceased have found deserved appreciation. Deeper it must be with all those who have learned, by personal experience, to admire besides his eminent talents the noble and amiable disposition of his mind.

Heinrich Rudolph Hertz originated from a prominent family in the city of Hamburg, where he was born on the 22d of February, 1857. After finishing the preparartory course for the university, he first devoted himself to the study of civil engineering at the Polytechnic School of Berlin, where at the same time he served his military term in the Imperial Railway Regiment.

More and more he felt an imperative attraction towards abstract scientific investigation. He consequently resolved to make physical research his special branch and pursued this line of study in the Universities of Munich and Berlin. The solution of a prize theme proposed for competition by the University of Berlin, in 1878, offered him a welcome inducement for a first trial of his ability for original scientific research. The problem was to determine by experiments in induction an upper limit of the kinetic energy of the electric current. A gold medal tendered with the most flattering comment on the cleverness and originality of the solution presented, rewarded Hertz for this first effort in scientific production.

The time of recreation offered by the ensuing Michaelmas vacations of 1879, brought out the second fruit of the work of the young scientist, this time purely mathematical in character. His treatise on "Inductions in Rotating Spheres" immediately placed him in the ranks of the most competent mathematical philosophers. He made it the basis of his application for the degree of Ph. D. Professors Helmholtz and Kirchhoff, his examiners, gave their official verdict on the dissertations, pronouncing it as "Doctrinae et acuminis specimen laudabile," a rare distinction from the tribunal of these authorities.

A short time thereafter, Prof. Helmholtz selected Hertz as his assistant in the Physical Laboratory of the University of Berlin, while at the same time he became a member of the "Physikalische Gesellschaft," the renowned society which embraces the most prominent German workers in physical research.

The period which Hertz spent in the quiet palace of the Physical Institute bore ample witness to the fertility of his mind in the most diversified branches of his favorite science. We find him equally engaged on problems in the provinces of elasticity, hydro-dynamics, heat and meteorology, the great majority of his researches however belonging to the department of electricity. Several practical instruments devised at this time illustrate the inventive disposition of his mind which is characterized in every instance by the originality and simplicity of the means employed.

The power of Hertz's judgment and his eminent mathematical talent soon secured him a prominent position in the estimation of the members of the Physical Society, and when in 1883 the University of Kiel inquired for a competent "Docent" on mathematical physics, and Hertz was selected for the position, the impression that the choice was the proper one was unanimous. Great satisfaction prevailed when, two years later, his superior merits were rewarded by the honors of a full professorship, the Government of Baden calling Hertz to the chair of physics in the Polytechnic School of Karlsruhe.

Here it was that Hertz carried out the celebrated investigation which gave him international fame and made him the centre of admiring attention throughout the scientific world. Decades had elapsed since by Maxwell's famous treatise the brightest prospects were opened for establishing a new and solid bridge between the departments of electricity and of light. Hundreds of the most able minds, thoroughly convinced of the intrinsic truth of the theory, were looking for means of its experimental verification, when Hertz presented the conclusive proof of the identity of optical and electrodynamic waves as the mature fruit of his wonderful and exhaustive researches.

In close succession the papers illustrating his systematic course of investigation followed each other. Starting with the development of the proper instruments of observation, keenly perceiving and clearly interpreting even the most minute and obscure indications of the same he soon proceeded to the application for the grand problem which they were destined to solve. Early in 1888 he was able to lay before the scientific world conclusive evidence of the finite velocity of the propagation of electrodynamic waves and of their close relationship to light waves. A few months later the full triumph of Maxwell's theory was established in every detail by exhaustive and overwhelming experimental proof.

One cannot read the series of papers embodying these researches, which soon created a sensation throughout the scientific fraternity, without deeply admiring, besides the rich fruit harvested at every step, the divining mind which is never misled by any complexity or obscurity of facts. The hearty delight enjoyed by the author himself in his intricate work finds an enthusiastic and almost poetical expression in the popular lecture by which the results were brought to the cognizance of a larger circle in the meeting of German Naturalists at Heidelberg in 1889, making Hertz's name one of the most popular of his country.

When in 1889 the University of Bonn was bereft of one of its most renowned celebrities by the death of R. Clausius, the famous pioneer in the mechanical theory of heat, the honors of the chair were offered to Hertz. He gladly accepted the call to the charming seat of science on the banks of the Rhine where his colleagues and the students were equally proud to offer him the most hearty welcome. While his lectures on experimental physics were addressed to a large number of students of all branches of natural science and medicine, a special course on mathematical physics gathered around him a select circle of pupils especially devoted to the field of physical research. His particular attention was directed towards increasing the facilities of the physical laboratory of the University so as to make it the centre of the efforts of those who under his guidance wished to enter the field of experimental investigation. In a colloginum he united with the more advanced of his students to discuss the leading problems and tried to introduce them into a full understanding of the productions of contemporary science.

The fame of Hertz's wonderful scientific success soon made his house the Mecca for a large number of visitors from all parts of the earth. The prominent feature that must strike everybody who made his acquaintance was the excessive modesty which gave a peculiar charm to his personal character. While ready to acknowledge emphatically every merit, however slight, in others, he never longed for praise for his own superior achievements. Free from any vain ambition he was exclusively governed by a pure and ardent desire for scientific progress.

In general conversation he showed a most diversified and universal interest. The earnest foundation of his scientific mind was accompanied by a sympathetic taste for the serene side of the human life, while the humorous touch which he liked to impart to his own narratives made it a fascinating pleasure to listen to him. To those who had once won his friendship he was dearly and permanently attached. His hospitable home—adorned by the charming wife (whose heart he had won during his stay in Karlsruhe) and by his two lovely children—was a picture of perfect happiness and offered the most cheerful abode to every guest who entered it.

A deplorable fate has severed the lovely bands which connected this unusual character to the highest scientific aims of the age, to his numberless friends and admirers, to the happiness of his cheerful home. Deep is the grief over this premature loss in every quarter of the scientific world. Endowed as very few are with the most acute perception of the secret ways of nature, combining the highest power of mathematical intuition with mastership in experimental investigation he seemed destined to lift the veil from many a mystery yet, and his friends confidently looked forward for further accomplishments of equal brilliancy to those by which he had filled the minds of his contemporaries with admiration. Seldom indeed has an early death dissipated brighter hopes than the passing away of our lamented friend, of whose life-work the very rays of light, the nature of which he so keenly disclosed, will speak to future generations. Bright as the laurels which he has joined to the wreath of honor of his nation will be the memory of his name in the hearts of all to whom science is dear; and brighter still will it be with those who were by personal friendship attached to his noble heart.

F. S. B.

ELECTRICAL UTILIZATION OF REFUSE AT HARROWGATE.

The City Council of Harrowgate, England, has resolved, it is stated, that an apparatus for the sorting and combustion of town's refuse be made a part of the electric lighting plant. Many "destructors" have been erected primarily with the object of burning the refuse, and the question of utilizing the heat evolved during such burning has either been entirely neglected, or at the best but a feeble attempt has been made to turn such heat to some useful purpose. On the basis of the results obtained in experimental tests there is enough fuel in the town ashpit refuse to supply steam power for an electric lighting plant double the size of the first equipment, and this without further capital outlay in a drying and sorting plant.

LITERATURE.

The Inventions, Researches and Writings of Nikola Tesla: With special reference to his work in Polyphase Currents and High Potential Lighting. By Thomas Commerford Martin. THE ELECTRICAL ENGINEER, *New York*, 1894. Illus. 496 pp., 6 x 9 inches. Price, $4.

THERE has been no one in the scientific field, unless it be the late lamented Heinrich Hertz, who during the past few years has attracted so wide attention among laymen and physicists alike as the subject of this sketch, nor has there probably been any one more generally misunderstood among all except those who have been specialists in somewhat the same lines as he.

Nikola Tesla, although for many years well known among electricians, has not until a comparatively recent date been known even by name to the layman, for he has appeared in public but a few times. The public lectures which he has delivered have attracted world wide attention however and have been faithfully reported by the electrical journals both in this country and abroad, but the intervals between their utterance have been such as to require closer attention even among professional men to connect them together than most of them have been able to give, and the newspaper reports were often so incorrect and even absurd, that the general opinion of what he had done has almost invariably been erroneous. Then too, all of his lectures have not been consecutive in thought nor intended to be, and it required a biographer thoroughly in the confidence of the great inventor and familiar with his work to fill in the gaps. And again, as I have said, by reason of the long intervals between his lectures, it became the more difficult to refer to the previous one in preparation for the new one. It involved the looking over of files of periodicals and these files were often wanting or inaccessible.

The purely popular interest with which Mr. Tesla's name and work have been surrounded may be imperfectly described by the standard of the throngs that were attracted to his lecture in St. Louis last spring. The largest hall in the city—the great auditorium at Exposition Hall—had been chosen for the occasion, yet this was jammed to the doors and thousands were turned away; while the scientific interest which they had aroused was equally well attested by the limited audience composed of the leading savants of all countries to which he spoke during the International Electrical Congress at the World's Fair.

The biographer in this case, Mr. Martin, was eminently fitted as everyone knows, to handle his subject in a literary way most satisfactorily, but it may not be so generally known that he was also eminently qualified for the task by reason of his long continued relations with, and friendship for, the man of whom he writes. With these two essential qualifications it would be strange if his attempt were not a successful one, and those who for these reasons expected an admirable fulfillment of the promise have had no cause for regrets at the result.

The book opens with an excellent full page portrait of Mr. Tesla. Then after a short preface and a table of contents comes Part I divided into 24 short chapters—the first one of which is chiefly biographical and introductory in character. The remaining chapters are devoted entirely to the polyphase current and its applications, describing his discovery of the now much used principle of the rotary magnetic field and the various applications which the inventor made of it. Each step is fully described and illustrated by cuts wherever the latter could be of service. Very much of this is either entirely new or, if previously published, so scattered as to render its collection by the average reader almost impossible. The experiments here described were all performed with alternating currents of the ordinary voltage and frequencies.

In Part II the author takes up Tesla's work with extremely high potentials and high frequencies. This will prove to many the most interesting part of the book as it may be said to be fundamental as respects that portion of his work which has aroused the most enthusiasm. It was the first public announcement of his work it this line that constituted Mr. Tesla's remarkable lecture before the American Institute of Electrical Engineers at Columbia College on May 20, 1891, and it was this same announcement that made him the cynosure of the eyes of the scientific world. The lecture itself is given in full in Chapter xxvi which is one of the eight comprising Part II.

It may be said at this point that it was only through the most untiring efforts and most urgent solicitations of Mr. Martin himself that this lecture was given at all, or rather, perhaps, that it was given at that time.

The enthusiasm aroused by this lecture abroad led Mr. Tesla to accept an invitation to England early in 1892, where he appeared before the Institution of Electrical Engineers, and a day later before the Royal Institution. The former of the two lectures takes up 97 pages and constitutes Chapter xxvii.

On Mr. Tesla's way to St. Louis to deliver his lecture there he stopped over at Philadelphia and addressed the members of the Franklin Institute—afterwards delivering with somewhat more elaboration the same lecture two or three days later before the National Electric Light Association meeting in Convention at St. Louis. This lecture, fully illustrated, constitutes Chap. xxviii.

The other four chapters of Part II are devoted respectively to Alternating Current Generators for High Frequency, Electrostatic Induction Apparatus, "Massage" with currents of High Frequency, and Electric Discharge in Vacuum Tubes.

Part III consisting of nine chapters, is devoted to what the author terms "Miscellaneous Inventions and Writings." This part is chiefly valuable as showing the great diversity of lines of research which Mr. Tesla has pursued. While it adds little to the book and practically nothing to the art, the volume would have been incomplete without it. A record of one's failures is sometimes quite as valuable to the world as a record of his successes. It certainly forms an appropriate chapter in the history of his achievements.

Part IV brings the history down to the time of the World's Fair. The first chapter of Part IV deals with Mr. Tesla's personal exhibit at the World's Fair. This is most admirably described and explained, and it is a pity that we did not have this chapter at least to inform us of the meaning and history of the many odd looking things while they were still assembled in Electricity Building. They were mostly historical machines each of which exemplified some important step in the evolution of now well known types; but the descriptions are accompanied by so many well executed cuts that many of us who saw them there will recall them, and if we did not then understand them, can now read the descriptions understandingly.

The second chapter—Chapter xliii—the last in the book, gives a running report of Mr. Tesla's lecture before the savants, already referred to. As this lecture was delivered to a limited few invited guests it was not taken down stenographically, but Mr. Martin has given a very fair abstract of it. The subject announced was "Mechanical and Electrical Oscillators," and those who were invited expected to hear the lecturer talk on some subject which his previous lectures had naturally led up to. What was their surprise however, to hear him talk about his achievments in an entirely different direction, namely mechanical reciprocating engines of an entirely new type, from which he hoped to obtain more easily, more economically and more surely, electrical results which he had already obtained by other means.

In conclusion it must be said, that Mr. Martin has been very happy in his language and exceedingly clear in his interpretations of hitherto misunderstood passages. He has done a real service to science in thus making accesible to all who desire it a complete and clear record of the sayings and doings of one who already has attracted so much attention and who, if not cut off like Hertz, to whom we naturally compare him, will do much more to entitle him to the niche in the temple of Fame which he has already earned. And it must be said further that the book is suitable not alone to those of technical acquirements but will be interesting to, and readable by, that now vast army of intelligent people who make science in its popular form a pastime.

NELSON W. PERRY, E. M.

LETTERS TO THE EDITOR.

MR. VAN NUIS ON THE PENNOCK "VOLT DISTRIBUTOR."

My attention has been called to a circular, issued by George B. Pennock, in which my name is unwarrantably used, and which, to say the least, is misleading.

To a casual observer, this circular would appear to be a report of an exhaustive test of the Pennock system of multiplying power by a "volt distributor," and assumes that I would be responsible for the statements and figures contained therein.

A more careful perusal of the subject, however, would reveal to the experienced engineer the real object of the author (to mislead) so there is little need of warning for those posted in such matters; but, for the benefit of laymen, and would-be investors in electrical enterprises, allow me to say, through the columns of your paper, that I have never made a detailed report of the Pennock system of distribution for anyone.

At the solicitation of a client, I called at Mr. Pennock's laboratory, to investigate the workings of the machine. After listening to Mr. Pennock's explanation of, and claims for, his crude apparatus, and taking several readings of the current output of his battery while doing various kinds of work, I was unable to report a multiplication, or saving, of power to any extent whatever, by the use of the "volt distributor," much less to verify Mr. Pennock's large claims to economy.

Before seeing Mr. Pennock's apparatus, I suggested to my client that the electricians of the country condemned it as a fraud, though I visited the exhibit in Boston with a fixed determination to give due credit to any point of merit I might be able to discover.

My search for merit was fruitless, but a careful survey of the exhibit, and of the methods employed by Mr. Pennock and his satellites, confirmed the report I had heard of this system in other localities.

A hungrier set of parasites is seldom seen, seeking as their prey any one with money. The bunco steerer's vocation seems mild when compared with this.

In the circular referred to, Mr. Pennock has arbitrarily assumed conditions and figures to suit his own conveniences, while the facts in the case do not warrant a single conclusion in this truly wonderful document.

C. S. VAN NUIS.

NEW YORK, Feb. 2, 1894.

NON-INFRINGING TELEPHONE TRANSMITTERS.

IN the columns of one of your esteemed contemporaries, a contributor undertakes, as he says, to point out to inventors the lines upon which they may work with a reasonable expectation of producing a practical non-infringing telephone transmitter. He refers, among other devices, to a pair of electrodes separated from each other and immersed in water, and to a pivoted lever attached to the diaphragm, which varies the resistance by moving a contact over the terminals of a rheostat. In the innocence of his heart, he cites these archaic and preposterous contrivances as proof "that it is possible to construct a *practical* transmitter without infringing the Berliner and Edison patents!" If this gifted scientist should ever, by any unlucky chance, find himself immured in a dungeon cell, under sentence to be deprived of food and drink until such time as he succeeded in making his wants known to the outer world through the instrumentality of a telephone transmitter of either of the above-named "practical" types, it is much to be feared that his fate would be no less tragic than that of the ill-fated prisoner who was condemned to be immured alive in a wall of solid masonry. It would seem as if the most elementary knowledge of the necessary conditions of telephonic transmission would have been sufficient to have prevented the publication of such worthless and misleading "expert" advice as is contained in the communication referred to.

HELLO-1-2-3-4-5.

BOSTON, Jan. 27, 1894.

ARC LAMP DESIGN.

In the London *Electrician* of Dec. 8 there appears a reprint of an article on the above subject by the writer, taken from THE ELECTRICAL ENGINEER of Nov. 15, which is commented upon editorially in that journal as follows:

> SOME of the difficulties in the design of arc lamps which are enumerated by Mr. W. A. TURBAYNE, in his article which we publish this week, are undoubtedly of importance; the others are rather trite. It is the fashion to say that the mechanism of arc lamps has been neglected, but, while this would have been true a year ago, it is not by any means true now, at any rate, as regards English lamps. During the last twelve months considerable attention has been given to arc lamps, both by makers, in regard to their mechanism, and by physicists, in regard to their distribution of light and the relation between watts, volts and carbons. However, it is quite true, as Mr. TURBAYNE points out, that there are still some important difficulties in the way of making a perfect lamp. But it is by no means clear how any of these difficulties are to be got over, in the case of running lamps in series, by a return to the old-fashioned series-coil method of feeding the carbons. To us, Mr. TURBAYNE's assertion that "the best foundation design for an arc lamp for direct-current working would undoubtedly be that of the *non*-differential variety," is simply unintelligible. The essential property of lamps run in series is that they shall regulate without influencing one another, and without any change of current. How can any such independence be obtained where there is a series feed?

Will you allow me space to set the writer of the above right as he has evidently misunderstood the general meaning of the term "non-differential" arc lamp.

In this country a non-differential lamp is generally supposed to be one in which the arc is controlled only by the shunt magnets; in other words, it is purely a shunt feed lamp and a lamp which certainly regulates when run in series, irrespective of the number in circuit, providing the E. M. F. is sufficient, as with any lamp, and the design is proper. It is needless to say that some of our most prominent systems of arc lighting now comprise a non-differential lamp and many of the constant potential lamps are also of this form.

I do not understand how the writer of the above criticism considered me to refer to a series feed, as my article plainly refers to a shunt feed lamp all along and positively states that "the main current has nothing whatever to do with the regulation;" this could hardly be called a series feed. We know that a lamp can regulate simply by the variations of main current, and such lamps are being made every day, especially single burning alternating lamps; but one would hardly have the nerve to propose such a thing for series lighting.

My article in THE ELECTRICAL ENGINEER, simply stated that the non-differential possessed numerous advantages over the differential form of lamp especially if the arc did not tend to elongate, during continued burning, by the heating of shunts or gradual decrease in weight of carbon, and thus call for a greater E. M. F. than the dynamo was capable of producing, resulting probably in serious "pumping," etc.

No one is more appreciative than myself of British arc lamps, especially of their substantial and weatherproof qualities.

WM. A. TURBAYNE.

DETROIT, MICH.

OBITUARY.

MRS. G. M. PHELPS.

It is with deepest pain and regret that we record the death, on Feb. 10, in Brooklyn, at the age of 47, after a brief illness, of Mrs. Annie Lapham, wife of Mr. George M. Phelps, president of THE ELECTRICAL ENGINEER. Funeral services were held on Feb. 11, and the body was carried next day to Troy for cremation and interment in the family plot in the cemetery there. Through her husband, Mrs. Phelps was known to a large circle of electrical friends and acquaintances, here and in Europe. Of her benevolence, charity, and sunny, serene disposition, a tender memory remains to her household and those among whom she went about quietly doing good. A painful death was faced with noble courage and sweetness. From the ENGINEER staff, as from all others who know them go forth profound feelings of sympathy with her daughter, and with the husband thus bereaved on the morrow of the twenty-fifth anniversary of his wedding day.

LEGAL NOTES.

LAMP SOCKET LITIGATION.

ON Jan. 25 argument was heard before Judge Coxe in the U. S. Circuit Court at Albany in the suit of the Edison Electric Light Co. (General Electric Co.) vs. The Electrical Engineering & Supply Co., of Syracuse, in the suits for infringment of patents covering lamp sockets. The patents sued on are those of T. A. Edison, No. 265,111, which is claimed to be the "foundation" socket patent; the metal covering patent of E. H. Johnson, No. 251,596; and three patents of S. Bergmann, Nos. 257,277, 293,552 and 298,658, covering various details. Messrs. R. N. Dyer and C. E. Mitchell appeared for the complainants and Messrs. Hay & Wilkinson for defendants. A decision is looked for within a few weeks.

MORE STORAGE BATTERY LITIGATION.—BRUSH vs. CHLORIDE.

THE BRUSH ELECTRIC COMPANY and the Consolidated Electric Storage Company as complainants have brought suit against the Electric Storage Battery Company (manufacturers of the "Chloride" accumulator), for infringement. Motion for preliminary injunction will come on to be heard before Judge Green in the United States Circuit Court at Trenton, on February 20. The suit is brought on the Brush storage battery patents, notably U. S. patent No. 337,299 for the broad claims covering the mechanical application of active matter, or matter adapted to become active, to a frame or support.

SWITCH PATENT LITIGATION.

THE suit of the Schuyler Electric Co. vs. the Electrical Engineering and Supply Co., of Syracuse, came up before Judge Coxe at Albany at the last term in January. This suit was brought for alleged infringment of the Perkins switch patent in the lamp socket, embodying a rotating ratchet and fixed pawl. Mr. C. L. Buckingham, appeared for complainants, and Messrs. Hay & Wilkinson for defendants,

EDISON ELEC. LT. CO. vs. DAVIS ELEC. CO.—APPEAL—LAMPS MUST NOT BE REPAIRED.

A decision on the appeal of the Davis Company against the decision of Judge Colt, in favor of the Edison Elec. Lt. Company, enjoining them from repairing Edison incandescent lamps, has been rendered by the Appellate Court in favor of the Edison Company.

SOCIETY AND CLUB NOTES.

THE N. E. L. A. CONVENTION AT WASHINGTON—SPECIAL TRAIN.

MR. C. O. BAKER, JR., Master of Transportation, has issued the following notice from headquarters. We may add that the attendance promises to be very large. It is said that some fifty ladies have already been registered to form part of the gathering.

> The various Passenger Associations have granted a rate of fare and one-third for the round trip from all points east of Chicago, Burlington and Peoria and the Mississippi River to Washington, D. C. Negotiations are now pending with the Western Traffic Association for members in that territory to secure this rate. Ask the ticket agents from whom you purchase your ticket for Delegate Certificate to National Electric Light Association Meeting, which, when properly filled in and certified at Association headquarters in Washington, will entitle you to return for one-third the regular fare.
>
> A special vestibuled train, composed of Parlor, Cars, will leave via Royal

Blue Line, Foot of Liberty Sireet, New York, at 1:30 p. m., Monday 26th inst.; and will leave Twenty-fourth and Chestnut Streets, Philadelphia, at 3:20 p. m., arriving at Washington, D. C., 6:20 p. m. Seat checks for this train can be procured from the undersigned at $1.25 each, and railroad tickets from New York to Washington at $6.50 each. Railroad tickets can also be obtained at any Blue Line Ticket Office. Be sure to get a certificate when purchasing ticket. Please make checks payable to C. O. Baker, Jr.

NEW YORK ELECTRICAL SOCIETY.—CANAL PROPULSION.

The next meeting of the Society will be held at Columbia College, 49th street and Madison ave, on Thursday, February 15, at 8 p. m. Mr. Joseph Sachs will deliver a lecture on: "Electric Canal Boat Propulsion, with special reference to the Erie Canal." *Synopsis:* 1. The Erie Canal agitation; 2. The necessary requirements for a feasible system; 3. Several ways in which boats can be electrically operated on the Erie Canal: (*a*) propeller, (*b*) cable hauling, Belgian system, (*c*) rack or rail hauling with stationary rail on bank or overhead, motor on boat gripping rail by means of an arm from the boat, (*d*) movable cable on bank and gripping devices on an arm extending from the boat, (*e*) motor on bank, i. e., locomotive on bank or overhead; 4. Comparison of the various methods and their efficiency, including the cost of installation and operation of propeller and hauling method; 5. General considerations of canals other than the Erie. The lecture will be fully illustrated by means of the lantern.

THE UNIVERSITY EXTENSION LECTURES.

The lecture by Mr. A. E. Kennelly, on Electrical Measurements, at Cooper Union, on Feb. 5, was well attended and was very interesting. The exposition of the subject, with the free aid of illustration, was in Mr. Kennelly's best vein, being clear, simple and thorough.

The lecture by Prof. F. B. Crocker on Electric Lighting, to have been delivered on Feb. 12, has been postponed until this evening (Feb. 14) as Monday was Founder's Day at the Cooper Union.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED JANUARY 30, 1894.

Alarms and Signals :—

Train Operated Device, J. H. Frischen and R. Pfeil, Berlin, Germany, 513,498. Filed Nov. 28, 1893.

A signaling device for steam railways arranged so as to have different effect upon the semaphores according to the direction in which the train is moving.

Fire Alarm Telegraph System, M. J. O'Sullivan, Baltimore, Md, 513,526. Filed June 7, 1893.

Electromechanial Device for Bells, &c., W. O. Meissner, Chicago, Ill., 513,587. Filed Sept, 11, 1893.

Annunciator, J. H. McEvoy, Waterbury, Conn., 513,592. Filed May 8, 1893.

Electric Bell, J. H. McEvoy, Waterbury, Conn., 513,593. Filed May 8, 1893,

Electrical Registering Device, F. Von Hefner-Alteneck, Berlin, Germany, 513,612. Filed Nov. 3, 1893.

The invention relates to apparatus for recording railway signals upon a strip of moving paper.

Annunciator, M. Garl, Akron, Ohio, 578,775. Filed June 28, 1893.

Automatic Circuit Closer, H. Lawers, Carson City, Nevada, 513,796. Filed July 11, 1893.

A thermostatic circuit closer especially adapted for automatic fire alarm.

Electric Alarm, D. S. Schureman, Rockford, Ill., 513,829. Filed May 6, 1893.

A dial thermometer with conductors so arranged as to make contact with the pointer and ring an alarm at a predetermined temperature.

Annunciator, F. W. Ross, Boston, Mass., 513,956. Filed Oct. 6, 1893.

Conductors, Conduits and Insulators :—

Anti-inductive Conductor, H. F. Chick, Waterton, Mass., 513,482. Filed May 29, 1893.

Employs a separator of textile material wound about and between the two conductars and permanently attached to one of them.

Electric Wire Cleat or Holder, A. W. Fuller, Saugus, Mass., 513,564. Filed Mch. 13, 2893.

Consists of a many-sided block having two parallel grooves formed upon two or more of its sides.

Detachable Electric Wire Holding Device, C. Beard, Brookline, Mass., 513,630. Filed Oct. 20, 1893.

A detachable clip embracing the support and provided with an eye through which the wire passes.

Connector For Electric Wires, E. H. Munson, New Britain, Conn., 513,949. Filed May 9, 1892.

A water tight coupling easily made and broken and especially adapted to testing apparatus.

Distribution :—

System of Electrical Distribution, C. H. Talmage, St. Louis, Mo., 513,839. Filed Mch. 31. 1893.

Relates to means for automatically regulating the quantity of electricity supplied to electrical translating devices.

System of Electrical Distribution, W. Stanley, Jr., and J. F. Kelly, Pittsfield, Mass. Reissued, 11,400. Filed Nov. 29, 1893.

Has for its object to provide a self regulating transformer system in which the primaries of the induction devices are connected in series with the main, or inducing, circuit and the translating devices in multiple with the secondaries by which they are supplied with current.

Dynamos and Motors :—

Commutator, G. A. Rollins, Chicago, Ill., 513,533. Filed Apl. 11, 1893.

Employs commutator bars secured and insulated at their ends and separated along their middle portions by air spaces.

Dynamo Brush, W. H. Fleming, Bayonne, N. J., 513,611. Filed Nov. 13, 1893.

Claim 1 follows:

A dynamo brush consisting of successive layers of wire gauze formed into the desired shape and then compacted by pressure. (See THE ELECTRICAL ENGINEER Feb. 7.)

Lamps and Appurtenances :—

Electric Arc Lamp, F. A. Perret, Brooklyn, N. Y., 513,725. Filed Nov. 7, 1892.

The invention consists of a train of wheels geared to the upper carbon rod, a rotary armature controlling the movement of said train, a pivoted frame supporting said train, and an electromagnet connected with the frame and controlling the rotary armature.

Electric Arc Lamp, M. R Gutierrez and M. T. Thompson, Jalapa, Mexico, 513,921. Filed Aug. 8, 1893.

Employs two carbons both supported at their right upper ends, the lower ends coming together in the shape of a V, and feeding mechanism for maintaining the lower ends at a proper distance apart as the carbons are consumed.

Incandescent Lamp Socket, J. McFarlane and W. B. Edgar, Glasgow, Scotland, 513,931. Filed Mch. 31, 1893.

The invention relates especially to a switch of cheap construction contained within the socket.

Metal Working :—

Electric Furnace, E. Thomson, Lynn, Mass., 513,602. Filed June 10, 1886.

Employs a heat producing conductor packed in a non-conductor of heat consisting of blocks of carbon pressed together.

Miscellaneous :—

Mechanism for Controlling Engines, B. F. Teal, Chicago, Ill., 513,601. Filed Aug. 14, 1893.

An electrically operated valve by means of which the steam pressure in the supply pipe is made to actuate a small piston closing or opening the steam passage.

Electrolytic Cell, C. T. J. Vautin, London, Eng., 513,661. Filed Apr. 19, 1893.

Claim 1 follows:

A mercury electrode comprising a chamber or pocket with mercury therein, the metallic joint internally surrounding said chamber, and capable of amalgamation with mercury and the non-conducting reticulated mesh sieve or perforated plate extending over the opening of the said chamber to hold the mercury in place.

Automatic Damper-Regulator, H. F. Maxim, Norfolk, Va., 513,948. Filed Mch. 14, 1893.

Railways and Appliances :—

Trolley Wire Finder, E. Gale, Peoria, Ill., 513,566. Filed Nov. 21, 1892.

Claim 3 follows:

The combination of the trolley pote and wheel with a revoluble finder-spool near the wheel, extending laterially beyond the vertical planes of the sides of the wheel, and mounted on lever-arms pivoted or in line with the journals of said wheel.

Electric Connection for Railway Rails, A. Green, Rochester, N. Y., 513,777. Filed Sept. 30, 1893.

Provides means for the removal or substitution of a single rail without interrupting the current.

Trolley Pole Stand, G. Valley, Cleveland, O., 513,846. Filed, May 6, 1893.

Trolley Pole Stand, G. Valley, Cleveland, O., 513,847. Filed May 11, 1893.

Electrically Propelled Drive Wheel, C. G. Anderson, Lynn, Mass., 513,859, Filed Sept. 1, 1892.

Employs a stationary motor arranged within the wheel and secured to the shaft, and intermediate gearing between the motor and the edge of the wheel.

Sectional Electric Railway, G. W. Demmick, Lynn, Mass., 513,894. Filed July 20, 1893.

A system in which the wheels of the truck make contact with the different sections of the conductor which are automatically cut out of circuit after the car has passed.

Power Transmitting Mechanism for Electric Locomotives, M. W. Dewey, Syracuse, N. Y., 513,895. Filed Apl. 17, 1891.

Employs an electric speed reducing mechanism connected to the moving part of the motor and to the shaft and consisting of two parts adapted to electrically attract or repel each other and a friction clutch connected to the moving part of the motor and also to the shaft.

Insulated Rail Chair, L. McCarthy, Boston, Mass., 513,950. Filed Sept. 27, 1892.

Switches and Cut-Outs :—

Circuit Controller for Regulators, B. B. Ward, New York, 513,545, Filed May 10, 1893.

An automatic circuit controller designed to have a certain amount of lost motion and then to make or break the circuit with an instantaneous snap.

Automatic Rheostat, C. J. Sturgeon, Erie, Pa., 513,626. Filed Mch. 31, 1893.

Switch Bar, F. A. Weller, Boston, Mass., 513,745. Filed Feb. 27, 1893.

A switch for shunt wound motors with which both the field and armature circuits may be instantly broken and again established through the greatest rheostat resistance when it is desired to start the motor.

Telephones and Apparatus :—

Signaling System for Telephone Circuits, J. I. Sabin and W. Hampton, San Francisco, Cal., 513,534. Filed Aug. 18, 1893.

Provides apparatus by which the subscriber operates a visual signal at the switching station automatically by the act of removing the telephone from its hook.

Signaling System for Telephone Trunk Lines, C. E. Scribner, Chicago, Ill., 513,537. Filed June 16, 1893.

Provides means whereby an operator in a telephone exchange is automatically notified of the connections established by other operators in the same exchange.

Telephone, H. S. Page, Somerville, Mass., 513,720. Filed May 15, 1893.

Employs a diaphragm of insulating material the outer surface of which is carbonized and the inner surface platinized, two electrodes in contact suspended by a conducting support, one being in contact with the platinized surface, and the whole included in the battery circuit.

Telephone Transmitter, F. H. Richards, Hartford, Conn, 513,729. Filed Dec. 4, 1893.

Employs a compound electrode supported upon the frame of the transmitter and a follower electrode connected with the diaphragm and supported against the working face of the compound electrode.

Telephone Transmitter, F. H. Richards, Hartford, Conn., 513,730. Filed July 31, 1893.

Similar to No. 513,729.

Automatic Telephone Switch, A. C. Wheat, Chicago, Ill., 513,960. Filed June 5, 1893.

Employs a shifting contact maker carried by the receiver hook and operating by gravity.

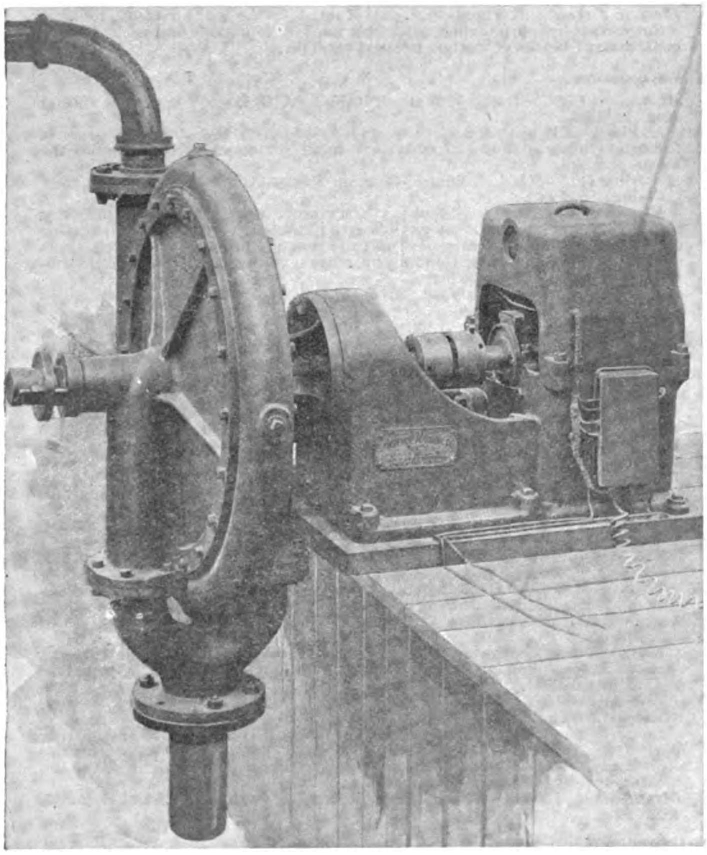
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

ELECTRIC CENTRIFUGAL PUMP.

AMONG the many types of electric pumps exhibited by the General Electric Company in its Power and Mining Section at the Chicago Exposition, the electric centrifugal pump, ejecting its broad stream of water into the reservoir in Electricity Building attracted considerable attention.

The pump itself, illustrated in the accompanying engraving, is a No. 4, four inch, centrifugal pump, manufactured by the Lawrence Company. The shaft of the pump is direct connected to the shaft of the armature of a General Electric iron clad No. 2½ W. P. motor, running at 400 revolutions at which speed it develops 8 H. P. This pump is intended for use where muddy or dirty water is encountered, which would quickly destroy the usefulness of any valves of the ordinary pump. It has proved remarkably efficient wherever it has been used, especially in raising water for irrigation purposes.



G. E. ELECTRIC CENTRIFUGAL PUMP.

J. G. WHITE & CO.

THE contract for erecting the electrical equipment of the Edmondson Avenue and Monument Street Lines of the Baltimore Traction Company has been let to J. G. White & Co. of this city, the contractors who have built all the other electric lines of the company. The Edmondson avenue line will be double-tracked to North avenue. At present there is only one track beyond the B. & P. R.R. bridge on Edmundson avenue. The Monument street line will follow the present tracks. If the weather permits, the contractors will commence setting poles at once. It is said the bidding was very close, and that superior construction work was the cause of the contract being awarded as it was. Mr. C. G. Young is the electrical engineer in charge of the work for J. G. White & Co.

THE ROBBINS PASTE BATTERY.

MR. A. C. ROBBINS, of Watsonville, Cal., has recently introduced a new dry battery for telephones, bells, annunciators, medical and spark coils, and all open circuit work. The Robbins paste battery is claimed to be as effective and as economical as the Leclanche, without the objectionable features of the latter.

It is also said to be non-poisonous and to contain neither acid, alkali, nor ammonia. The number 1 size, 3 inches high and 2½ inches in diameter, will, it is claimed, operate an ordinary call-bell and push-button circuit satisfactorily for from six months to one year, without any attention whatever. When exhausted, this battery can be recharged by a current of from two to five volts from an ordinary gravity battery. The battery is made in six sizes.

SWEDISH CHARCOAL IRON FOR ARMATURES AND TRANSFORMERS.

THERE is probably no one thing which has contributed more to progress in the construction of dynamos and transformers than the recognition of the fact that heating and other losses are due largely to the inherent quality of the iron employed. What may be very good soft iron for some purposes may be totally unfit for work of this kind and it has required much time and experience to manufacture the quality of iron best suited to this purpose. Among those who have devoted special attention to the manufacture of iron for armatures and converters are Messrs. Jos. Sankey & Sons, of Bilston, England, who are represented in this country by Mr. Geo. L. Colgate, of 136 Liberty street, New York. Transformer work is specially trying to the iron and the perfection to which the above mentioned firm have brought their Swedish charcoal iron is seen from the fact that transformer stampings show only an average loss of $\frac{6}{10}$ of a watt per pound, at a frequency of 100, with an induction of 4000 C. G. S. units; this is claimed to be more than equal to the mild steel used by some manufacturers in this country and the cost of the iron is considerably less than the steel. The use of this iron in armature cores reduces the heating effect and materially increases the efficiency of the machine.

One great advantage to the manufacturer is that Messrs. Sankey & Sons make no charge for tools that may have to be made on account of deviations from the sizes and styles of stampings they have already made, and for which they have tools in stock. Aside from the great advantage of the quality in their iron there are also other advantages to the manufacturer, notably the following: The stampings come to him ready for use; he needs no large investment in presses and other special tools; he needs no department in his factory to accommodate these tools and the necessary workmen; and he saves the waste and the repairs and the cost of labor and he gets a uniform iron.

There is another point which has been found to be of great importance, and which is quite necessary where the iron is used in transformer work, and that is, that stampings that have been bent and straightened again do not give the same results as when the iron is carefully kept flat, and it is believed the iron loss in the company's transformer stampings is considerably less owing to careful handling, than when the stampings are made by inexperienced people.

Another point of importance is that in the process of annealing the iron is given a finish which does away with the necessity of placing insulating material between the plates.

Since Mr. Colgate has begun to introduce this iron into America, he has secured orders from many of the leading companies, and in every instance it has given entire satisfaction and secured permanent customers.

"N. I. R." WIRE IN CHICAGO.

THE METROPOLITAN ELECTRIC COMPANY, General Western Agents for "N. I. R." wire and cables, have just recently had some very satisfactory tests from two of the largest buildings in Chicago, in which their wire is used.

The "N. I. R." factory have enlarged their line of products, and are now making electrolier wire, lamp cord, rubber and friction tape; all in harmony with their regular wires and cables.

A full stock of these goods will be carried by the Metropolitan Electric Company, at prices to suit the times.

PURITY OIL FILTER CO.

THE list of recent sales of the Purity Oil Filter includes names of companies from California to New York and from Wisconsin to West Virginia, besides which many applications for machines on trial have been received. An improvement of considerable merit in these filters has lately been made, the particulars of which may be learned by addressing the company in Pittsburgh.

THE ELECTRIC APPLIANCE COMPANY have recently added several improvements to their now celebrated Washington alternating arc lamp which make the lamp even more desirable than it was as originally placed on the market. A highly polished metal reflector has been placed over the outside of the globe which can be used or not as desired. The metal base of the lamp has been done away with entirely leaving nothing whatever on the lower part of the globe to obstruct the light and also shortening the lamp several inches, so that a 15 hour lamp is only a trifle over 20 inches long over all.

OHIO BRASS COMPANY RAILWAY SPECIALTIES.

The accompanying illustrations show some new devices for electric railway work, just being introduced by the Ohio Brass Company of Mansfield, Ohio. Figs. 1 and 2 represent Wood's adjustable two and three way switch. The tongues of this switch being pivoted in the body admit of a wide range of adjustment, and it can be used equally well for a right hand, left hand or Y turn out. The two way style will answer for all turn outs, which makes it very convenient for new work. The three way switch is substantially the same as the two way except that the pan is made broader to admit of the use of three tongues. In fastening the short end of the trolley wire in the switch no soldering apparatus is required. The wire is laid in the tongue and the clamping pieces at the ends are hammered down over it and held in place securely by means of the screw cap and clamping piece which is attached to a lug on the tongue of the switch. This also acts to fasten the tongue at the desired angle.

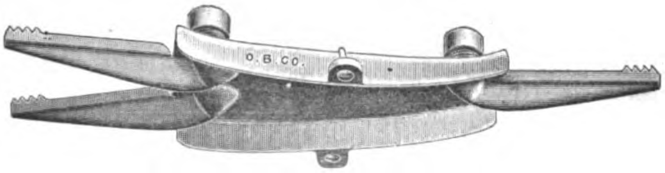


FIG. 1.—WOOD'S TWO-WAY SWITCH.

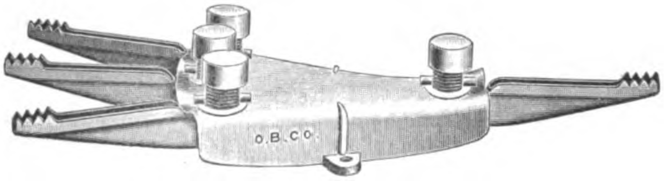


FIG. 2.—WOOD'S THREE-WAY SWITCH.

The threaded trolley splicer is shown in Fig. 3. To make a splice the ends of the trolley wire are threaded with a small die furnished for the purpose, and the thimbles are then screwed on and fit into the recesses in the coupler. The two parts of the coupler are then screwed into each other making a strong compact splice but a trifle larger in diameter then the wire itself.

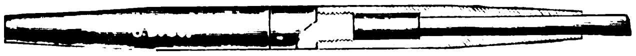


FIG. 3.—THREADED TROLLEY SPLICER.

The feeder wire splicer, Fig. 4, can be used as a permanent or temporary connector. The halves of the splicer are placed over the abutting ends of the bare wire, and the nut is then screwed on the tapered ends. These are slightly corrugated on the inside to securely clamp the wire. If a permanent splice is desired solder can be poured through a slot provided for this purpose. A joint made in this way is but a trifle larger than the wire and is of low resistance and great strength.

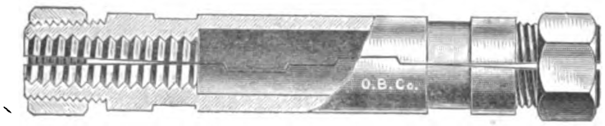


FIG. 4.—FEED WIRE SPLICER.

BERLIN IRON ROOFS.

The Berlin Iron Bridge Co., of East Berlin, Conn., have received the contract for an iron roof for the boiler and engine room of DeLand & Co., at Fairport, N. Y. The roof will be covered with The Berlin Iron Bridge Company's patent anti-condensation corrugated iron. The new mill of The Diamond Mills Paper Co., at Millbank, N. J., is being put in place by The Berlin Iron Bridge Co. The Citizens' Gas Co., of Brooklyn, N. Y., have placed the order for an iron roof for their new producer house, with the Berlin Iron Bridge Co. The building is 69 ft. wide and 151 ft long, with an iron roof covered with slate.

QUEEN "HOT WIRE" INSTRUMENTS.

QUEEN & Co., INC., of Philadelphia, are about to introduce a variety of standard voltmeters on the "hot-wire" plan made under the fundamental Cardew and other more recent patents. These instruments prove extremely accurate for both direct and alternating circuits, which is confirmed by an award received at the World's Fair for "Success attained in *overcoming* the defects of the ordinary hot-wire instrument, viz.: Lack of great range through which the instrument is sensitive, great correction due to change of temperature and inconstancy of zero point, and also for its compactness, portability and excellence of mechanical construction."

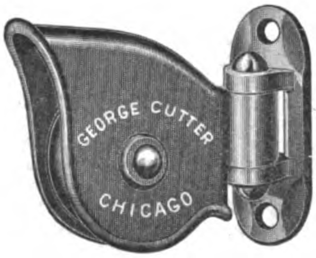
Exhaustive experimental work conducted in the Queen laboratory for more than a year past, enables the makers to feel great confidence in the efficiency of the "Acme" standard voltmeters, the portable type of which will be ready for sale in a few weeks. A price list and full particulars will be issued shortly.

SOUTHERN NEW ENGLAND TELEPHONE CO.

THE above company with headquarters at New Haven, Conn., has issued a very neat calendar for 1894, of which a copy has been sent us, accompanied by a list of towns and post offices in Connecticut and by a memorandum book that contains a list of pay stations for the use of non-subscribers. All the data is useful and well prepared.

CUTTER'S NEW POLE PULLEY.

The new year would not be doing itself justice if it did not bring some more of the "better things" devised by George Cutter. The first of these comes in the shape of a new swivel pole pulley, well shown by the cut. Most of our readers are acquainted with the older form of swivel pole pulley, which has been used extensively for several years, and which is said to be giving the best of satisfaction. The new type is built on the same general lines, but instead of requiring a special screw for fastening it to the pole, it has a wall-plate which can be secured with a couple of ordinary lag screws. This wall plate is made of malleable iron and curved so as to fit the pole, making the support both strong and quite rigid. That such a pulley will always swing into line with the hoisting rope so as to avoid any chafing of the rope, is evident, and this point, added to its other good features, will no doubt command a good market for it. It is made and handled by George Cutter of Chicago.



CUTTER'S NEW POLE PULLEY.

INFRINGEMENT OF THE STAR VENTILATOR.

IN the Omaha *Sunday World Herald*, of December 17th, appears a paragraph in regard to an alleged infringement of the patent of Merchant & Co.'s Star ventilator. It would seem that the Star ventilator was specified for the Lincoln, Neb., Hospital for the Insane and that the contractor placed other ventilators in the building, which Merchant & Co. claimed to be infringements on their Star patents. Steps were accordingly taken to stop payment on the work pending an investigation. The matter was duly laid before the State Board of Public Lands and Buildings, with the result that the board decided to withold a settlement with the contractor until he had made a satisfactory settlement with Merchant & Co. We are informed that Merchant & Co. have recovered heavy damages in the case.

REDUCED PRICES FOR "SECO" LAMPS.

THE SOUTHERN ENGINEERING CO., of Louisville, Ky., has issued an announcement of reduced prices for its "Seco" incandescent lamps, making the rate 32½ cents for lamps up to 20 c. p.; 38 cents for 25 c. p. and 45 cents for 32 c. p. Special prices will be quoted on special lots or special makes. Any lamp proving defective within ten days of normal use will be replaced free of charge.

RE-ORGANIZATION OF THE MATHER ELECTRIC COMPANY.

FOR several weeks a movement has been on foot for the transfer of the Mather Electric Company of Manchester, Conn., to a syndicate of Hartford capitalists. All the details of the transfer have now been arranged and new men will take charge of the company and its affairs. The old directors resigned Saturday, and at a meeting of the stockholders in the afternoon at the Phoenix National Bank, officers were chosen as follows: President, Maro S. Chapman; vice-president, T. C. Perkins; secretary and treasurer, John L. Bunce; directors, Charles E. Perkins, T. C. Perkins, M. S. Chapman, Henry A. Redfield, Charles M. Jarvis, John L. Bunce, Norman McD. Crawford.

Mr. Charles E. Perkins is a well-known lawyer in Hartford, and his son Mr. T. C. Perkins, who becomes vice-president, will assume all the active duties of the management. Mr. T. C. Perkins is well known in New England, and though still young in years, has had a varied experience in the electrical field, and knows well just what kinds of dynamos and motors are required. He is also well known in the West, having been associated with Mr. W. B. Pearson in the management of the Chicago office of the Ball & Wood Company. Mr. Perkins has the reputation of being enterprising and pushing in the extreme, and will lend all his youthful energies to the business. Mr. Henry A. Redfield is president of the Phœnix National Bank, Hartford. Mr. C. M. Jarvis is widely known as the general manager of the Berlin Iron Bridge Company, of East Berlin, Conn. Mr. Chapman is in charge of the Government Envelope Works in Hartford, and is also president of the Perkins Electric Lamp Company, and the Waring Electric Company. Mr. Crawford is a consulting electrical engineer of Philadelphia, and is at present electrician of the Hartford Street Railway Company. Mr. Bunce who will be directly associated with Mr. Perkins has had several years' experience in the electrical business, having been with the Schuyler Company and the Perkins Switch Company.

The new officers have engaged as superintendent of the electrical and manufacturing departments Theodore Gonet, an electrical engineer who is at present with George Westinghouse, of the Westinghouse Electric and Manufacturing Company of Pittsburgh. He will have associated with him W. E. Powell, who is now with the Mather Company. The company starts out under the re-organization free from debt and with a working capital of about $80,000 outside of the stock capitalization of the company. Electrical supplies of various kinds will be made, but the company will make a specialty of large dynamos and generators for electric lighting plants and electric street car systems.

Recently the Mather Company made an addition to their factory of a building 200 feet by 50 feet, with a traveling crane capable of lifting 20 tons, so that they are now well equipped to manufacture the largest sizes of generators and dynamos. The old ring type of machine will still be used, but new types will be developed in the heavy railway generators as soon as practicable. The shops are running light at present, but it is expected that a large force of men will be put to work in the near future, and before long it is hoped that 200 to 300 men will find employment with the Mather Company.

MUNICIPAL CONDUIT SYSTEMS IN MASSACHUSETTS.

A bill has been introduced into the Legislature of Massachusetts to enable cities and towns to construct, maintain and lease conduits and the connected structures for electrical wires, cables and conductors. The bill provides that

> Any city or town in which electrical wires, cables, etc., are in use over, along or across any public way, may accept the provisions of the act, and thereupon proceed to construct, operate and maintain conduits, manholes and the necessary distributing boxes and service pipes connected therewith and may compel any and all corporations, firms and individuals using the wires, etc., to place the same in such conduits and man-holes and compel owners of wires within ninety days after the service of notice to remove the same from over or across public ways; if the wires are not removed within ninety days, the city or town may remove them at the cost of the owner; a city or town may defray the cost of such conduit by issues of bonds to be called "Conduit Loan Bonds," to run not over thirty years and bear interest at a rate of not more than five per cent.; a rental not exceeding $500 per mile annually for each three-inch duct in the conduit may be charged for use of the conduit.

Nothing in the act is to be construed as referring to trolley wires of street railway companies or supporting wires for the same. In case there is an existing conduit in a city or town it may be taken upon terms agreed upon by the parties, or at a price, in case of disagreement, fixed by a method provided for by the bill. No public highway is to be interferred with without the consent of the public highway commission.

UNDERGROUND WIRES IN ST. LOUIS.

PRESIDENT McMATH of the St. Louis Board of Public Improvement says that in case a conduit system is required by the city a grand trunk subway would probably be built to lie north and south. It would be built very like a sewer, the material used in its construction being either brick or concrete. The interior would be large enough for workmen to move in, and the cables carrying the wires would be laid on shelves or brackets on the sides.

In this subway would be laid all kinds of wires, including the supply wires of the street railroad and electric light companies. At right angles from this grand trunk subway and at intervals of not less than two blocks submains would be required, consisting of 20 or less ducts, carrying the cables of all companies. These conduits could be laid under the sidewalk and when put down be subject to calculations ahead for 25 years or more.

No permits are now granted for the excavation of basement or cellar areas within four feet of the curb line, this four feet being reserved by the Board of Public Improvements for city use for whatever purpose that space may be most available, and it is in this space that the subways will probably be placed.

WESTERN NOTES.

THE JONES BROS. ELECTRIC CO., Cincinnati, O., are about to bring out a new lightning arrester in three designs—one for station work, one for outside work, and one for electric cars.

ST. LOUIS ELECTRICAL SUPPLY CO.—Mr. E. Rubel, President of this company, was at the Auditorium, Chicago, for several days last week, looking after some important business for this company.

MR. CHARLES WIRT, of Wirt indicator fame, has just bought the entire stock, tools, fixtures and "good will" of the Wirt Laboratory, formerly owned by the Ansonia Electric Co. Mr. Wirt in addition to the manufacture of the well-known "Wirt" brush will now manufacture his indicator. Mr. D. B. Cheever for many years with the Ansonia Co. remaining in charge of that department.

THE UNDERWRITERS' HATCH DOOR CO., Chicago, of which Hon. Jno. W. Hepburn is president and general manager, are overwhelmed with orders for their automatic electric hatch doors, by which all the floors of an elevator shaft are automatically closed in case of a fire starting in any part of the building. This company is soon to extend its operations to all the larger cities of the United States.

P. & B.—The Metropolitan Electric Company have just taken the General Sales Agency for the P. & B. specialties, which include paint, armature varnish, electrical compounds, tape and Chatterton's compound. A large stock will be carried at their store and ware rooms, 186–188 Fifth Avenue, and prices will be made the same as from the factory.

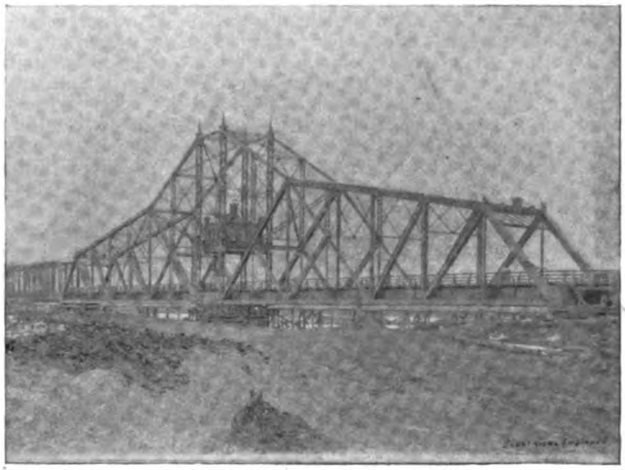
CROUSE-TREMAINE CARBONS. Appreciating the demand which has existed for some time for a stock of high grade electric light carbons in Chicago the Electric Appliance Company have made arrangements to carry a stock of the celebrated Crouse-Tremaine carbons in Chicago sufficient to meet all reasonable demands for prompt shipment. They are also prepared to bid on large quantity orders for direct shipment from factory.

RAPID TRANSIT FOR NORTH CHICAGO.—Among the important measures that came before the Chicago Council at its last meeting was a proposition for extensive electric lines on the North side, which, it is claimed, will do away with the horse cars and transfer slips. The North Chicago Electric R.R. Co. made the proposition, and it has been recommended by the Council Committee on Streets and Alleys, North, D. H. Louderback, J. L. Cochran and others, who control the Evanston Ave. electric line, are said to be behind the scheme, although Mr. Cochran says the two companies are independent of each other. The discussion of the proposed ordinance in the council promises to be a stormy one.

MR. J. L. BARCLAY has moved into his new business quarters on the 16th floor, in the South end, of the Monadnock Building. The offices are well adapted for Mr. Barclay's electrical interests, and primarily selected by him for exploiting the Walker Manufacturing Company's electric railway and power machinery. The Central and Western departments of the Company's business are under Mr. Barclay's immediate supervision and management. Mr. H. McL. Harding, who is also interested in the above Company, has his headquarters for the Eastern department, in New York. While the general electrical interests of the Walker Manufacturing Company will receive the combined attention of Messrs. Barclay and Harding, all business directly connected with the Western and Middle States will be transacted at the Chicago headquarters. The appointment of District and Sales agents is now receiving attention. At this time, particularly, little trouble will be encountered in securing competent men. Mr. Barclay feels very much encouraged at the business outlook, notwithstanding the financial depression. Inquiry for the heavy types of generators and motors, such as the Walker Company manufacture, are numerous.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.
Vol. XVII. FEBRUARY 21, 1894. No. 303.

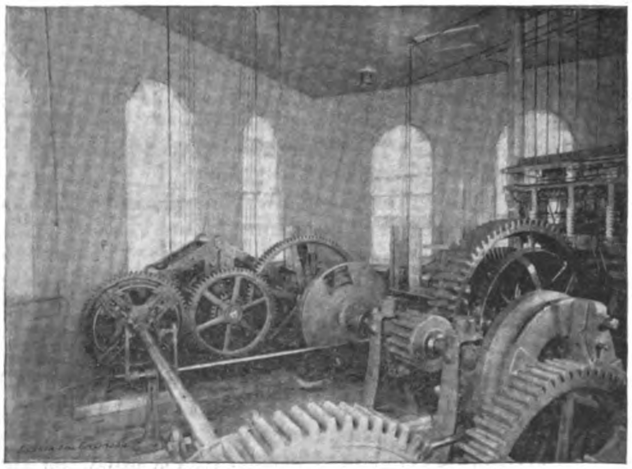


East Omaha and Council Bluffs Draw Bridge.

THE STORAGE BATTERY ON A DRAW BRIDGE, AT OMAHA.

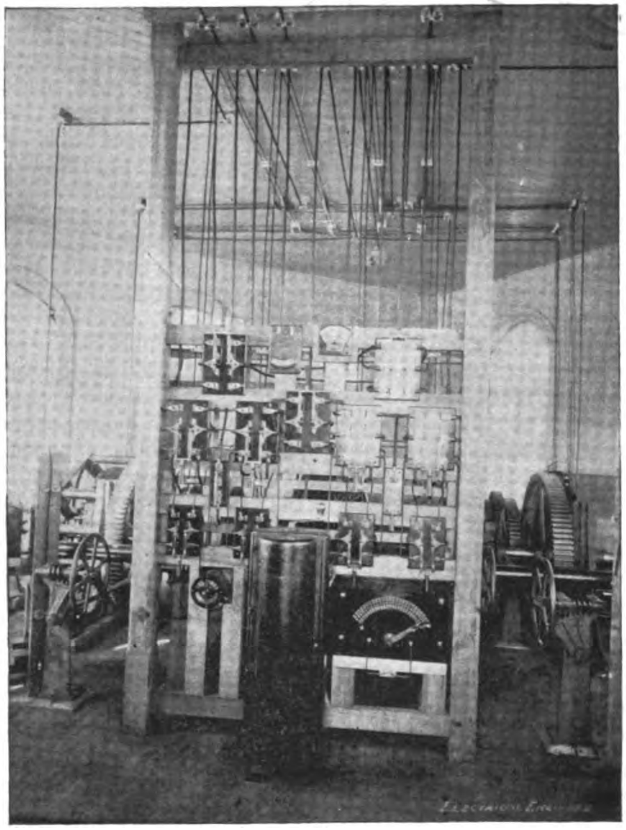
ONE of the most interesting applications of the storage battery is that recently successfully tested, and now in actual operation, on the 520 foot span of the Omaha Bridge and Terminal Company's draw bridge between East Omaha and Council Bluffs. The draw weighs between three and four million pounds and is swung in about four minutes by two Waddell-Entz motors of forty h. p. each, taking current from 384 cells of copper-steel alkaline storage battery arranged upon eight racks, each two in series, giving four distinct units. The motors, batteries, switchboard and gearing are all contained in a tower at the middle of the span forty feet above the road bed. The cells are charged from the trolley wire of the East Omaha Street Railway Company. The whole battery may be charged in series or it may be divided into two parts and each charged separately, and the machinery may be worked from one-half the battery independently of the other half if desirable.

The motors are geared to the main shaft that turns the bridge, and also to another shaft that operates the locking mechanism, both through the medium of friction clutches. The main shaft is cut at its centre and an equalizer is introduced to distribute the strain upon the large rack. The main gear wheel is five feet in diameter with a six inch face. An electric signal tells when the tracks on the bridge are in line, that the draw may be stopped exactly at that point.



View in Tower of Omaha Draw Bridge.

It is not supposed that the draw will be swung many times in the year for the passage of steamboats, but to keep it in good order the company will probably open and shut as often as once a week.



Switchboard in Omaha Draw Bridge Tower..

SENSITIVE CELLS.

In a letter to *Nature* of January 18th, Prof. Minchin describes some results obtained by him at Dara-mona House, Westmeath, by aid of Mr. W. E. Wilson's two-foot reflector in measuring the photo-electric effect of the light of the planets and fixed stars. The sensitive cells employed were seleno-aluminum-aenanthol cells, three square millimetres in area, and were connected with the telescope in place of the eye-piece. Clifton's form of the quadrant electrometer was employed. An electromotive force of 1 volt was represented by 460 scale divisions. Venus (quarter of disc) gave 40 divisions; Sirius, 9 divisions. Aldebaran gave no result.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—VII.

BY

Mary A. Henry

It should be remembered that Henry had not only discovered the relation between the intensity magnet and battery, but also that between the quantity magnet and battery. The arrangement just described was an intensity combination; Henry also tested the quantity combination. The apparatus for this, made jointly by Dr. Ten Eyck and himself, is in existence. It consists of a wooden frame, in which hung one of Henry's earliest quantity magnets now detached, but with the apparatus on a shelf attached to the frame is an insulated solid coil of short, very thick wire; there are two little magnets, with armatures so arranged that they can strike a hollow metal cone, used instead of a bell. This formed a convenient portable means of exhibiting the action of the electrical current. When Henry left Albany it was used by his successor, Dr. Ten Eyck, to illustrate Henry's discoveries, and was given by Dr. Ten Eyck to a favorite pupil, who is still the owner of the interesting relic. The reader knows the place the short quantity circuit holds in the telegraph.

We have glimpses of the telegraph in 1830 and the two following years through the eyes of Mr. Orlando Mead, late of Albany, who was one of Henry's pupils; he says:

"The older students of the Academy in the years 1830, 1831 and 1832, and others who witnessed his experiments, which at that time excited so much interest in this city, will well remember the long coils of wire which ran, circuit upon circuit, for more than a mile in length around one of the upper rooms in the Academy, for the purpose of illustrating the fact that a galvanic current could be transmitted through its whole length, so as to excite a magnet at the farther end of the line, and thus move a steel bar, which struck a bell. This, in a scientific point of view, was the demonstration and accomplishment of all that was required for the magnetic telegraph. The science of the telegraph was here complete. * * * Let us not forget that the click of the telegraph which is now heard from every joint of those mystic wires which now link together every city, and village, and post and camp, and station all over this continent is but the echo of that little bell first sounded in the upper room of the Academy."[1]

The following is another testimonial of an eye-witness to the operation of this telegraph. The Hon. Alexander W. Bradford, also a pupil of the Academy under Henry in 1831, says in an address, on the same occasion.

"And there is another professor, whose life has been spared, who rose with the sun to instruct his pupil, eager for knowledge; who, giving his heart and soul to the duties of the school, had yet time for exploring the deep paths of science; who, with his wires and silk thread, winding wires of insulated copper in the Commencement Hall of the Academy, patiently toiled his way to the demonstration of the magnetic power of the galvanic battery; and years before the introduction of the telegraph proclaimed to America and Europe the means of communication by the electric fluid. I was an eye-witness to those experiments and to their eventual demonstration and triumph."

Dr. James Hall, the distinguished geologist, (in the year he was president of the American Association) in a letter to Prof. Henry dated January 19, 1856, gives the following reminiscence.

Dear Sir:—While a student of the Van Rensselaer School, in Troy, New York, in August, 1832, I visited Albany with a friend having a letter of introduction to you from Prof. Eaton. Our principal object was to see your electro-magnetic apparatus, of which we had heard much, and at the same time the library and collections of the Albany Institute. You showed us your laboratory in a lower story or basement of the building, and in a larger[2] room in an upper story some electric and galvanic apparatus. In this room, and extending around the same, was a circuit of wire stretched along the wall, and at one termination of this, in the recess of a window, a bell was fixed, while the other extremity was connected with a galvanic apparatus. You showed us the manner in which the bell could be made to ring by a current of electricity, transmitted through this wire, and you remarked that this method might be adopted for giving signals, by the ringing of a bell at the distance of many miles from the point of its connection with the galvanic apparatus. All the circumstances attending this visit to Albany are fresh in my recollection and during the past years while so much has been said respecting the invention of the electric telegraph, I have often had occasion to mention the exhibition of your electric telegraph in the Albany Academy in 1832, (*Smithsonian Report*, 1857.). If at any time or under any circumstances this statement can be of service to you in substantiating your claim to such a discovery at the period named, you are at liberty to use it in any manner you please, and I shall be ready at all times to repeat and sustain what I have stated, with many other attendant circumstances should they prove of any importance.

I remain very sincerely and respectfully yours,

James Hall.

Professor Joseph Henry.

This telegraph of Henry's was properly an acoustic telegraph. The telegraph when first introduced into general use, in various ways, by dots and lines or printed letters, recorded its message on a moving slip of white paper; but the operator of to-day listens to its sound, and writes the message, and so it has come to pass that the telegraph is to-day again an acoustic telegraph, and its click heard everywhere is, in Mr. Mead's expressive phrase, *functionally and in truth* but the echo of that little bell which first sounded in that upper room in the Albany Academy.

BRENNER'S ONE-VOLTMETER METHOD OF SWITCHING DYNAMOS IN PARALLEL.

In order to ascertain when the voltage of a dynamo is at the right point for switching it on to a line in parallel with others, one of two methods is employed. In the first, two voltmeters are used, one to indicate the voltage of the line and the other that of the dynamo. Both of these instruments must be calibrated so that their readings correspond, and, if one of them give a false reading, as might easily happen, the generator may not be thrown on to the line at the right moment. In the second method, one voltmeter only is needed, which is connected alternately with the line and the dynamo by a switch. Though this method has an advantage over the first in requiring but one voltmeter, it has the disadvantage that the voltage of the line may change while that of the dynamo is being measured. This is a serious objection in electric railway power stations where the pressure on the line is continually fluctuating.

The advantages of each of these methods are retained and their defects overcome by an ingenious system devised by Mr. W. H. Brenner, the electrical engineer of the Montreal Street Railway Co., of Montreal, Canada. His arrangement, which requires but one voltmeter, has been used for some time in the Cote Street power station of the company, where it has given great satisfaction owing to its convenience and accuracy. By this system the generator to be switched in is connected temporarily to the line in series with the voltmeter in such a manner that the voltage of the dynamo opposes that of the line. The voltmeter then indicates the difference between the two voltages and thus the proper time to throw in the generator is ascertained.

The system as arranged at Montreal is shown in the accompanying diagram which represents the four generators in the station ready to be switched on to the line.

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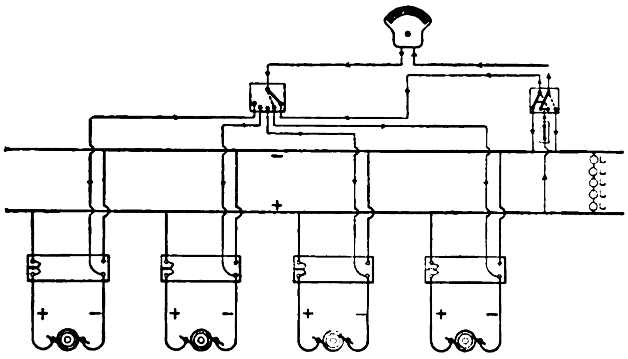
[1] Address on the celebration of the Semi-Centennial Anniversary of the Albany Academy, June 23, 1863.

[2] The rooms are about the same size, the upper one seemed larger, probably, because the lower was filled with raised seats.—M. A. H.

Lamps L L are inserted between the positive and negative bus in order that the circuits may be more easily traced. It should be explained that power is also supplied to the railway system by two other stations. One of the terminals of the voltmeter, which is a Weston station instrument, is connected with the line through a reversing switch and the other terminal is connected with a five-point switch, the first contact of which is connected with the reversing switch and each of the four others with the negative terminal of one of the generators. The positive terminal of each generator is connected with the positive bus by bridging this side of its main switch with fuse wire.

To indicate the voltage of the line, the five-point switch is placed upon the first contact, as shown in the diagram. When it is desired to throw in a dynamo, the connections of the voltmeter are reversed by the reversing switch; the new position of the switch being shown by the dotted lines. The voltmeter pointer will now move off the scale beyond the zero point. The five-point switch is then moved upon the contact connected with the generator which is thus connected to the line in series with the voltmeter. If these connections be made before the generator is started, the high resistance of the voltmeter prevents an appreciable current from flowing through the circuit.



ONE VOLTMETER METHOD OF SWITCHING DYNAMOS IN PARALLEL.

The positive terminal of the generator being connected with the positive bus, the voltage of the generator opposes that of the line. If the line pressure be the greater, a current will flow from the positive bus, through the generator and the voltmeter, to the negative bus. If the voltage of the generator be the greater, the current will flow through the voltmeter in the opposite direction, and the voltmeter will indicate the difference between the two pressures. In the first case, the voltmeter would indicate the difference in two voltages, if its connections be reversed by the reversing switch. When the voltage of the generator equals that of the line, no current will flow through the circuit and the indication of the voltmeter will necessarily be zero. In this way the proper time for switching in a generator may be ascertained with one voltmeter without any possibility of error, even if the pressure on the line be continually fluctuating.

EFFECTS OF THE STORM.

ONE of the most convincing arguments in favor of underground wires, if indeed such argument were necessary, was the severe storm which visited Chicago on February 19. While nearly all of the overhead lines suffered more or less from the effects of the blizzard, the underground service of the fire alarm, police telegraph, telephone, Postal and Western Union, as well as of the several electric light companies, met with no interruption whatever. Outside of Chicago the damage to the wires was rather severe, the greatest trouble to the telegraph lines being reported in the south-west, near Cincinnati, as well as in the neighborhood of Columbus, O. The Long-Distance service seemed to have suffered the least, showing the advantage of superior line construction, where underground work is impracticable.

THE GUTMANN INDUCTOR DYNAMO.

THE many different types of dynamo and motor produced, would make it appear that radically new types are scarcely to be expected. Occasionally, however, a new one does crop up, the most recent example of this kind being the machine of Mr. Ludwig Gutmann of Cleveland, Ohio. Hitherto most of the designs have been directed towards securing the most effective magnetic circuits, to obtain which, mechanical construction and other considerations have been frequently neglected to a considerable degree.

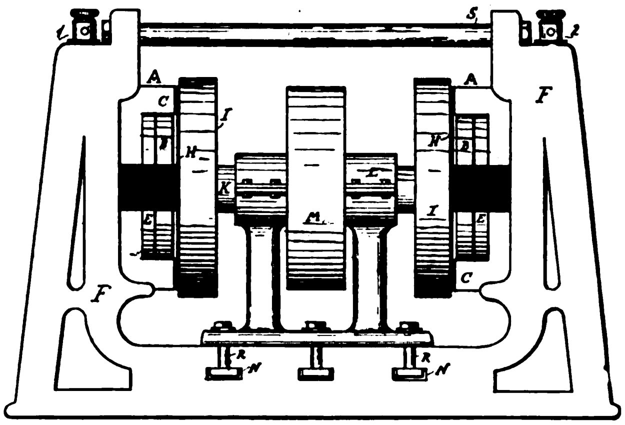


FIG. 1.—THE GUTMANN INDUCTOR DYNAMO.

This was specially noticeable at the World's Fair when observing the loading, unloading and mounting of dynamos, armatures, etc. Looking at these devices from a mechanical standpoint it was apparent that a heavy armature with its bearings far apart, which is necessitated by the interposed field magnets, has decided disadvantages. The two principal ones are, first, the great care required in handling such armatures to prevent damaging the insulation of the field magnet coils as well as armature in mounting or removing the same; and secondly, the constant watch that is required so that the bearings may not be worn down to so great an extent as to cause a considerable one-sided pull on the armature, resulting in springing of the shaft, and causing the revolving armature to rub against the field magnet poles. Another weak point not to be underestimated is that in most machines a heavy casting forming part of the field magnet has to be removed to obtain access to the armature. In the new type designed by Mr.

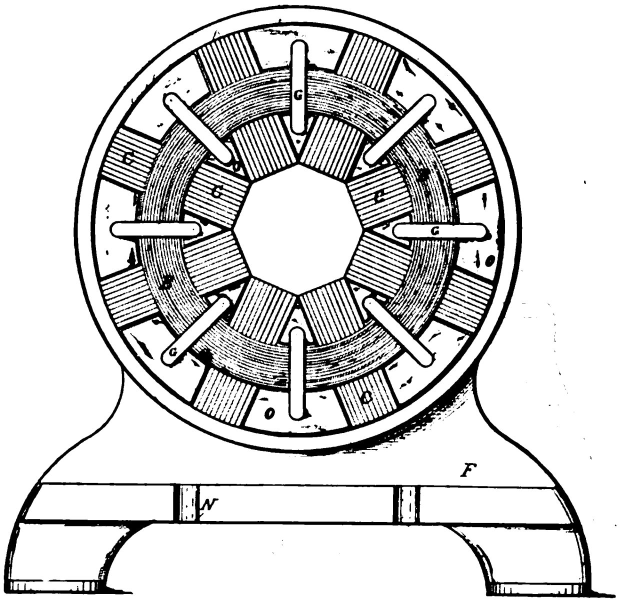


FIG. 2.

Gutmann these disadvantages seem to have been removed entirely. Fig. 1 shows a front view of the commercial machine in elevation.

The dynamo, which may be used as an alternator or continuous or polyphase current machine, belongs to the inductor type. That is to say, in this machine the armature winding as well as the field winding is stationary and only a small portion of the core is made to rotate and induces alternating currents in the armature windings by the increasing or decreasing resistance of the magnetic circuit, and, in consequence, a varying number of lines of force cut the armature winding. In Fig. 1, the field magnet is divided into two parallel structures A A, whose polar projections are grouped around a centre common in each structure, and each of them has but a single coil B for energizing all of the magnets C. This field winding, as shown in Fig. 2, is placed in a recess which is made large enough to also embrace the armature coil E. Both these coils are securely anchored in the main casting F by suitable cleats G in such a manner that even the cleats are below the surface of the projecting poles.

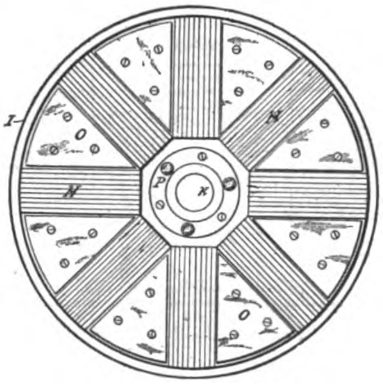


FIG. 3.

Between these two field magnet structures are located the two rotary core parts H, which, like the field structures, are laminated and mounted on a steel or bronze disc I and secured to the rotary shaft K, which rests in bearings L. The driving pulley M has a central position. By preference this machine, especially when used as an alternator, is separately excited but can be made to be self-exciting. The duplication of parts to the left and right of the pulley may lead one to assume that the alternator is a double machine ; however it may be said that the reaction of the armature winding on the field winding is such that a single side operated alone would not give satisfactory results unless modified to overcome the reaction just named. In the present machine it is overcome by suitable connection of the windings and by placing the core parts of the rotary element H so as to intersect the one with the other. The casting of the field magnet structure is shown to form in part the bed plate for the bearings and is provided with slots N enabling the bolting down of the independent armatures at the proper place and sliding them to one side at any time for inspecting the windings, without necessitating the removing of brushes, which are not required on this machine, nor the opening of any wire connections. The construction and location of the core parts and windings will be clearly seen in Figs. 2 and 3. To prevent the circulation of heavy air currents and consequent humming noise emitted by multipolar machines, blocks of china or wood O are placed between the core spaces.

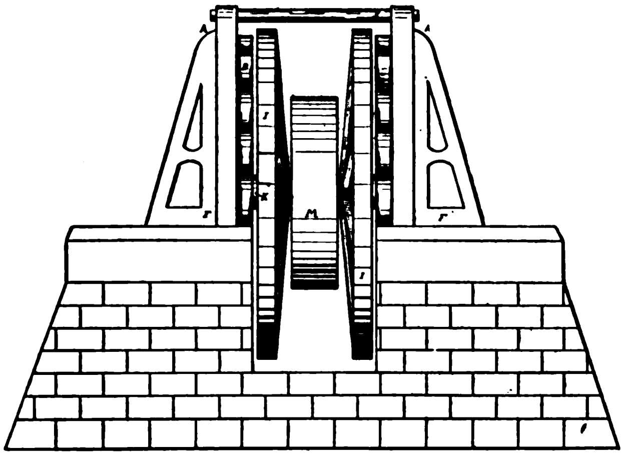


FIG. 4.

A distancing or thrust bearing P is provided at the end so as to keep the rotary iron masses far enough from the stationary core projections. The ends of the field exciting spools terminate at binding posts 1 (one of which covers the other behind it in the illustration), and similarly those of the armature spools are connected to binding posts 2. In the larger machines these parts are attached to the back of the main casting, where they are easily accessible and at the same time properly protected against mechanical injury by the projecting iron masses.

From Fig. 1 it will be evident that the movable part is in a perfect mechanical balance, that the armature shaft has the shortest possible length and that the central application of the driving force,—which, by the way, need not be a pulley but may be the gear of a turbine or the crank of an engine or the engine itself,—is the most suitable position obtainable, where the armatures themselves act as flywheels. The wearing of the bearings will have hardly any effect on the operation of the dynamo. It can never be the cause of a one-sided pull.

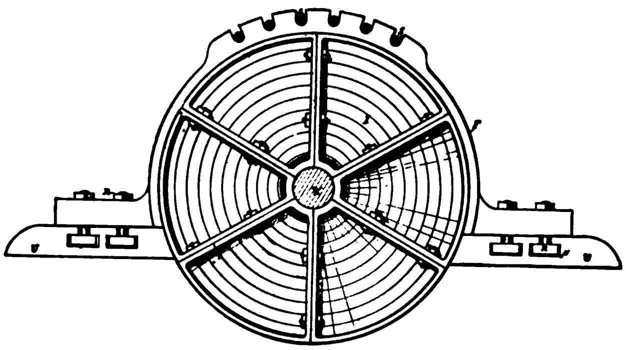


FIG. 5.

For the larger machines, Figs. 4 and 5, several modifications become desirable, as owing to the increased dimensions, the double coil construction becomes too cumbersome, especially if handling and shipping is taken into consideration. On this account the coils are subdivided and the cores are placed with the lamination in the direction of rotation so as to prevent heating by eddy currents, which in the form shown in Figs. 1, 2 and 3 are avoided by properly shaping the field poles; and lastly, instead of moving the armature or rotary structures, each of the field magnets is provided with means to be slid sidewise to enable a man to go between the armature and the field magnet. Fig. 4 represents the dynamo in front elevation and Fig. 5 is a view looking from the pulley to one side showing the armature in front of the stationary core parts and windings. The greatest stability is obtained by placing the armature bearings L on the ground as in common engineering practice. The armature core supports are built up in sections similar to a flywheel. To the side of the wheel are fastened the core block for changing the resistance of the magnetic circuit Z. The armature extends down into the pit while the field magnet cores and stationary windings are located in parallel planes properly secured and held apart at the bottom by the armature shaft and braced at the crown to prevent bending towards the rotary armature due to magnetic attraction. To admit inspection of the windings the T-bolts R are loosened at the side to be inspected as are also the bracing rods S in the crown of the field structure whereupon, by means provided on the bed plate U, such as screws and suitable handles, the field magnet structure slides sidewise on its bed-plates.

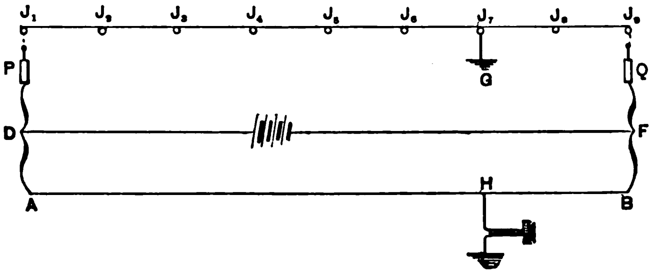
The many advantages of this construction for direct connected, or belt or turbine driven machines, are apparent; also that this type is well adapted for ship-lighting, as the engine can be mounted directly on the dynamo base plate, or vice versa. The central location of the driving force and the perfect balance obtainable render this type especially favorable for direct connection with engines, as the wear and strain on the latter owing to their position must be less than when the pull or twist is a one-sided one as must inevitably be the case if the dynamo is placed on one end of the shaft of an engine.

LOCATING TELEPHONE SWITCHBOARD TROUBLES.

BY

Jas. W. Manson

DIFFICULTY is often experienced by telephone men in locating grounded lines in multiple switchboards, more especially in those of the latest design, where the series method of arranging jacks has been abandoned, and what is known as the "bridging system" has been substituted.



MANSON METHOD OF LOCATING TELEPHONE SWITCHBOARD TROUBLES.

In the old style of multiple board, a line can be opened at any desired point, by simply inserting a blank plug, and trouble located in that way; but in the bridging board this is not possible, and the usual method employed is to examine successively every jack till the cause is actually located. Where the board has a large number of sections, this is tedious and unsatisfactory, the trouble-man being very apt to overlook the often almost microscopic contact in the attempt to quickly cover the entire board. It seldom happens that the fault is found before the majority of jacks has been inspected; and every jack unnecessarily looked at means just so much loss of time, not to speak of wear and tear to wiring due to the use of wedges.

The writer, having had occasion recently to clear such troubles in a board of the latest make, hit upon a plan for locating them, a description of which may be of service to those of your readers placed in a similar position. The principle involved is that of the well-known Wheatstone bridge reduced to its simplest form.

In the diagram J^1, J^2, etc., represents one side of the jacks of a line in its course through the board; A B is a naked wire extending the length of the switchboard and joined at its extremities to the plugs P and Q; and D F a battery wire branching to the naked wire and the plugs as shown.

Suppose the plugs inserted in the first and last jacks of a line having a ground at G, and that a receiver grounded on one side has its other side free to touch the naked wire at a point H, opposite to G; then, D P G : D A H : : G Q F : H B F; or the same conditions found in a balanced Wheatstone bridge. By tapping with the free side of the receiver on the naked wire at intervals along its length, the spot where a balance can be obtained is easily and quickly found.

Experience has shown the writer that this is a very delicate yet practical test. Crosses and short-circuits may also be located in the same way by grounding one of the lines in trouble and locating in the other. A neater arrangement to give quicker results may be used by bringing D and F to a short length of fine German silver wire, divided into proportional parts, and striking a balance on it, as before; the principle is the same.

COPPER ECONOMY OF ALTERNATING CURRENT SYSTEMS.

BY

Chas. Steinmetz.

SINCE quite erroneous statements are frequently made, even by otherwise well informed people, on the copper economy of alternating current systems, i. e., the amount of copper required to transmit a given amount of power with a given loss of energy, it may be of interest to investigate this question somewhat further. Before discussing different systems of transmission, however, it is necessary to establish a basis for the comparison, and this can only be equality of potential, for it would obviously be useless to compare, for instance, a 1000 volt three-phase, with a 2000 volt single-phase system, since it is evident that a system of higher potential will be more economical in copper.

When trying to compare different systems of transmission we meet with the further difficulty, that in some systems different potentials exist. So, for instance in the ordinary Edison three-wire system the potential between the neutral and outside wires is only one-half the potential between the outside wires; or in the interlinked quarter-phase system, i. e., the quarter-phase system with common return, the potential between the outside wires is 41.4 per cent higher ($\sqrt{2}$) than the potential per phase. We have to decide, therefore, which of the different potentials shall be used as the basis of the comparison.

In long distance transmission, in transformers, and all high potential apparatus, the practical limit set for the potential is merely due to the electrostatic strain on the insulation and the liability to disruptive discharge caused thereby. Since the electrostatic strain, and therefore the reliability of the system—other things being equal—depends upon the maximum potential existing in the system, the only proper basis for the comparison of different systems in this case will be, equality of maximum potential existing in the system.

Again, in other cases, as, for instance, power distribution for small motors, the danger to life is the limiting element. Here again it is the maximum potential which is the determining element. Take, for instance, an interlinked quarter-phase system, with 500 volts per phase, i. e., $500 \times \sqrt{2} = 707$ volts between the outside wires. Such a system will obviously be more dangerous than a 500 volt single-phase system, and will indeed be equivalent in danger to life to a 707 volt single-phase system. Hence in this case the only proper basis of comparison is the equality of the maximum potential also.

In some cases, however, especially in the low potential networks supplying incandescent lamps, the potential is necessarily so low as to cause practically no strain on the insulation, nor any serious effects in touching live wires;

but since lamps of more than 110 volts are not yet used in general practice, in this case the ability of supplying apparatus requiring a definite low potential must be the standard of comparison; that is, in this case, the different systems have to be compared on the basis of equality of the minimum potential in the system. We shall therefore have to carry the comparison through on the basis of equality of maximum potential (long distance, transformer and motor work), as well as on the basis of equality of minimum potential (low potential incandescent lighting).

Table I.

COMPARISON ON THE BASIS OF EQUALITY OF MAXIMUM POTENTIAL IN THE SYSTEM.

To transmitt the same power over the same distance with the same loss of power, that is, with the same efficiency, the amounts of copper required are:

2 wires, single-phase system	**100**
3 wires, three-phase system	**75**
Interlinked quarter-phase system	**145.7**
Interlinked quarter-phase system with 3 equal wires	**150**
4 wires, independent quarter-phase system	**100**

If in a given system of electrical transmission we double the potential, the same energy will be transmitted by one-half the current. Since the loss in the transmission line is equal to $C^2 R$ the resistance may be quadrupled to give the same efficiency, i. e., only one-quarter the copper is required, or, in other words:

The amount of copper required to transmit a given power with a given loss of energy is inversely proportional to the square of the potential, other things being equal.

The simplest way to compare different systems of alternating current transmission, as single-phase, three-phase, etc., is to bring them to comparability by reducing them to their component one-wire systems in the following manner:

The single phase system with two wires of a difference of potential e can be considered as consisting of two circuits of one wire each and a potential $\frac{e}{2}$, i. e. the potential between one wire and the neutral point or centre.

The three-phase system with three wires and a difference of potential e between the wires, consists of three circuits, each of one wire and of the potential $\frac{e}{\sqrt{3}}$, the potential between the wire and the neutral point, which in this case is the centre of gravity of the equilateral triangle formed by the three line potentials.

It follows from this at once, that the amount of copper required to transmit the same power with the same loss of energy in these two systems is inversely proportional to the squares of the potentials of the component one-wire systems, i. e., as $\left(\frac{1}{2}\right)^2 \div \left(\frac{1}{\sqrt{3}}\right)^2$ or as 4 is to 3. This means: *That the three-phase system requires* $\frac{3}{4}$ths *or 75 per cent. of the copper necessary in a single phase system of the same potential.*

The quarter-phase system with independent circuits, i. e., with four wires, requires the same amount of copper as the single-phase, since it is nothing else but two independent single-phase systems. Using one wire as a common return for both phases the current in this wire will be increased by $\sqrt{2}$; the loss of energy in this wire being doubled it will therefore be the same as before in the two wires, so that the efficiency is the same as with independent circuits; in other words one of the wires, or 25 per cent. of the copper is saved, and an interlinked quarter-phase system, or quarter-phase system with common return requires 75 per cent. of the copper necessary for a single phase system, having the same potential as the potential of the quarter-phase system per phase.

If, however, the potential per phase of the quarter-phase system equals e, the potential between the outside wires is $e \times \sqrt{2} = 1.414\ e$, and if compared on the basis of equality of maximum potential the interlinked quarter-phase system of the potential e per phase has the same maximum potential, i. e., the same strain on the insulation as the single-phase system of potential $e \times \sqrt{2}$. Since this single phase system requires only one-half the copper of the single-phase system of potential e, the interlinked quarter phase system requires not 75 per cent. but 150 per cent. of the copper required in the single phase system to transmit the same power with the same loss of energy, when compared on the basis of equality of maximum potential in the system, i. e., on the basis of equality of the strain on insulation and danger to life.

In this case, where for the interlinked quarter-phase system three equal wires are used, the current density of the common return will be greater than in the outside wire, i. e., the disposition of the copper will not be the most economical. Making the cross section of the common return 41 per cent. larger than that of the outside wires, i. e., using the most economical arrangement of equal current density in all three conductors the amount of copper required in the interlinked quarter-phase system is reduced from 150 per cent to 145.7 per cent (more exactly $\frac{3 + 2\sqrt{2}}{4}$).

Table II.

COMPARISON ON THE BASIS OF EQUALITY OF MINIMUM POTENTIAL ON THE SYSTEM.

To transmit the same power over the same distance with the same loss of power, that is, with the same efficiency, the ratios of copper required are:

2 wires, single phase		**100**
3 wires:	**Edison 3-wire, single phase system, neutral = ½ cross section of outside wires**	**31.3**
	Edison 3-wire single phase system, neutral = full cross section of outside wires	**37.5**
	Interlinked quarter phase system	**72.9**
	Three-phase system	**75.0**
4 wires:	**4-wire single phase system, inside wires = ½ cross section of outside wires**	**16.7**
	4-wire single-phase system, inside wires = full cross section of outside wires	**22.2**
	Three-phase system with neutral wire	**33.3**
	Independent quarter-phase system	**100.0**
5 wires.	**5-wire single-phase system, inside wires = ½ cross section of outside wires**	**10.9**
	5-wire single-phase system, inside wires = full cross section of outside wires	**15.6**
	Independent quarter-phase, with common neutral.	**31.3**

In the low potential distributing networks for incandescent lighting, where the proper basis of comparison is equality of minimum potential in the system, a considerable saving of copper is effected by the use of multiple wire systems, as for instance the Edison 3-wire system. Replacing the two-wire system by three, four or five wires, with the same potential between the adjacent wires the potential between the outside wires is increased 2, 3 or 4-fold, and thereby the theoretical amount of copper required reduced to one-fourth, one-ninth and one-sixteenth. In practice somewhat more copper is required, since the neutral or intermediate wires must have some cross section also. Thus in the Edison three-wire system theoretically, i. e., for the two outside wires, one-fourth the copper is required as for the two wire system. If, however, the neutral wire is made of the same cross section it increases the amount of copper by 50 per cent., to three-eighths; or if the neutral wire has one-half the cross section of the outside wire it increases the copper by 25 per cent. to five-sixteenths. In this case the interlinked quarter-phase system has to be credited with 75 per cent. and 72.9 per cent. respectively, of the copper required in the two wire system.

It is hardly necessary to explicitly give calculations for all the different arrangements, since anybody who understands multiplication and division can easily derive the results, and it may be sufficient to refer to the accompanying tables which may be of convenience for reference in deciding upon the choice of the proper system.

Coming now to the comparisons of the continuous current with the single phase alternating current we see that the copper economy of both is the same, if the comparison is made on the basis of equality of effective potential as for low potential net work and probability of danger to life.

In high potential lines where equality of maximum potential is the basis of comparison the single phase current of potential e has the maximum potential (with the assumption of a sine wave) of $e \times \sqrt{2}$, and therefore compares with a continuous current potential $e \times \sqrt{2}$; that is, the continuous current circuit can be worked at a 41 per cent. higher potential and then requires only 50 per cent of the copper of a single phase alternating current, under the condition of the same *electrostatic* strain on the insulation.

This comparison is not fair, however, since the continuous current causes an electro-chemical strain on the insulation by electrolysis which does not exist in alternating current circuits but is in continuous current circuits probably more severe than the electrostatic strain; besides, since the continuous current is practically out of the question anyway for high potential work the comparison of the equality of maximum potential between continuous current and alternating current is of little interest. I need only add that these numerical results are identical, so far as they go, with the figures given by Kapp, and others who have made a careful investigation of this question.

ELECTRICITY AS A MOTIVE POWER IN THE DENTAL OFFICE.

BY

Thos. H. Berry

VERY few electricians have given this branch of motor work any thought, and many of those who have attempted to supply the dentist with motors have failed more or less because they failed to understand the requirements, and the peculiar and severe tests that a dental motor is put to. Others have given it up because the small demand and small power used does not warrant them in spending much time in its study and application.

The operation of dental apparatus is perhaps one of the severest tests of an electric motor. There is no other use that a motor is put to (unless it be in operating elevators), where it would receive as sudden changes and be called upon for such varied requirements as in the office of a busy dentist. Let us see what is done: A hundred times a day, or more, it is started, stopped and reversed under different conditions. For instance, it is started suddenly without any load at full speed, then the load is thrown on suddenly as when grinding with a large wheel in the mouth. The load is then thrown off all at once and motor stopped suddenly from full speed, or perhaps reversed from full speed to full speed in opposite rotation. Again it is stopped suddenly while running at full speed; I mean, stopped on one half a revolution while running at perhaps 2,000 revolutions per minute, as is necessary when the drill becomes caught in the rubber or between the teeth. Here we have to overcome the sudden electric strain on the motor and also the heavy sparking at the switch and brushes. Again it is often necessary to reverse the motor while running at full speed and perhaps without load. Here we have the counter electromotive force of the armature to contend with, for the higher the speed and the lighter the load, the greater the counter E. M. F. Again, we want to run at very slow speed and still have good torque and good regulation of power. The next moment we want very high speed and good power.

One who has not been brought face to face with all these various requirements would at first thought say, "It is not much of a trick to set up a ⅛ or ⅙ h. p. motor for a dentist." And many electricians have attempted to supply the dentist with what they supposed was all the dentist needed; and thus the dentist has not used the electric motor as much as he would have done, had it been all he could ask for. Another feature which makes success more difficult is the complication of switches, rheostats, friction clutches and motor generators, where the power is regulated by throwing resistance into the generated current circuit. All of these tend to confuse the dentist and make the combination more apt to get out of order and be thrown aside for the old foot power.

After making it a study for several years and having the advantage of being a dentist myself and so knowing what the requirements of such a machine are, I am able to lay down a few useful points, which I have proved in practice to meet the requirements, and which I hope may help the electrician to meet the demands of the dentist, and also furnish food for thought on the subject so that my profession may reap the benefit of the progress made in electricity.

Speaking now of a motor used for operations in the mouth and operated on the 110 volt continuous current, a good, well-made, quiet running, shunt wound, ⅛ or ⅙ h. p. is all that is required. With this there is needed a switch, preferably operated by the foot, that will handle the motor through a rheostat. The usual way is to place the rheostat in series with the armature for variations of power, and the usual way to reverse is to reverse the current in the armature. The quick stop is usually produced by a cone or magnetic clutch in series with the fields.

My objection to the first and last are these: With the rheostat in series with the armature we do not get the same relative variations of regulation and power throughout the different degrees of power. For instance, on the slow speed we have the armature partially magnetized, revolving in a saturated or highly magnetic field; we do not get the same relative regulation and torque on slow speed as on full speed, because the relation between the current in the armature and field is vastly different from that at full speed.

The cone or magnetic clutch throws the work on and off the motor suddenly without in any way preparing the motor for the sudden change; besides, it adds complication to the combination of parts. It also allows the motor to be suddenly reversed without first stopping it, which is, as we all know, not a safe plan to follow, especially with small motors on high voltage circuits. The better way is to employ a switch that will operate in the following way: At the first move of the switch the fields and rheostat are thrown in series, and, at this same point, the armature terminals in short or closed circuit. At the next move the armature and fields are thrown in shunt, and these in series with the second step of the rheostat; here we have the slowest speed, and the armature and fields are both receiving their relative amounts of current. The regulation and torque is in the same proportion to the power as it is at full speed. The next step of the rheostat gives more power, and so on up to full power. Now, to suddenly stop at this point, the rheostat is cut in to the first step where the fields are in series with the whole resistance and the armature on short circuit; at this point we have the armature revolving in a partially magnetized field. It really now is a dynamo, generating a current through the armature closed circuited, and this current is what was the counter current of the motor. As it now requires power to continue the generation of this current, and as the armature is receiving no outside power other than its momentum, it suddenly comes to a stop. The next move throws the fields and rheostat in series off, with little or no sparking with so small a motor. The next move back or opposite, again throws the fields in series with the rheostat and armature closed circuited. The next throws in the armature in shunt, but in reverse current; here we have slowest speed in reverse rotation, and the next step gives more power; and so on, up to full speed.

By this method it is impossible to reverse the motor from full speed ahead to reverse full speed without throwing in the rheostat, short circuiting the armature, and thus overcoming the the counter E. M. F., and at every move it puts the motor in its best condition for work at that speed or power.

At the time the armature is on closed circuit, the fields are only slightly magnetized, as the rheostat is in series; hence we do not get the heavy sparking at the brushes that we would by closing the armature in a strong magnetic field. The shunt and relation between the fields and armature remains the same at all differences of power, as the rheostat is in the main and not in the shunt. At the same time it converts any good make of shunt motor into a good dental motor without any addition or change to the motor. All the variations are produced electrically in the motor, and none mechanically as by electric brakes or clutches. In fact, there is no friction or rubbing of parts during quick stop, and so no noise or clicking of a magnetic clutch. All is so simplified that the motor is in just as favorable a way to operate under the required variations as it is for fan work or any constant load.

I have been operating on this plan for four years, and it has proved to be very practical and satisfactory in its operation, and very sensitive to variations at all stages of the dentist's work.

THE COPPER-ZINC ACCUMULATOR.—IV.

BY

Paul Schoop

THE necessity of a porous partition between the anode and the cathode has already been alluded to. As is well known, such a membrane does not contribute to the simplicity of the apparatus. Desmazures employs parchment paper in his cell; Phillips and Entz cover the copper cable with a layer of cotton. Experience with the lead accumulator has shown that the capacity of the same cell increases if either the positive or the negative plates are wrapped in envelopes of asbestos or parchment paper or similar sheets. The rapidity of diffusion or the rate at which the liquids inside and outside of the electrode mix is decreased and since the charged active material alone does not yield any current, unless there be present the proper amount of the necessary electrolyte, it will be seen that the porous partition is rather a drawback. Besides, the durability of parchment paper or cotton with strong caustic potash solution is not above suspicion.

In this field, Professor Aron of Berlin invented his mercury-zinc accumulator about ten years ago. This combination consists of a cathode and an electrolyte precisely the same as that of the copper-zinc battery, but instead of the suboxide of copper as an active material oxide of mercury is used. This means a decided improvement in several directions. First, there is no further necessity for the porous partition. Like the oxide of copper, the oxide of mercury is not perfectly insoluble in the caustic potash solution; but even if a trace of mercury should be dissolved, this would have no deleterious effect on the zinc electrode. In contact with the zinc plate, mercury will be deposited on it and thus amalgamate the zinc and protect it against local action. This is just contrary to what we have seen in the case of copper, traces of which give rise to a tremendous local action on the zinc plate. Furthermore, the voltage of the mercury-zinc accumulator is far above that of the copper cell, being about 1.40 volts as against 0.85 volts, for the latter. It would therefore seem, other things being equal, that the mercury cell would at once surpass everything else in this line. But unfortunately the conductivity of the oxide of mercury, as it is formed by the electrolytic action during the charge seems to be very low and thus hinders its practicability. Instead of suboxide of copper, oxides of manganese have been also proposed as active material (L. von Orth, Leipzig). Although it is obvious that manganic acid will be formed during the charge, still, if this body should reach the zinc plate, no local action will occur.

The circulation of the electrolyte is another important point in connection with the alkaline accumulator. While Desmazures proposes to stir up the electrolyte mechanically from time to time, Messrs. Phillips and Entz have devised a heating method, which, it is claimed, performs the necessary mixing of the liquid. When the discharge of the battery is going on, the solution of zinc, formed on the zinc side, sinks to the bottom, being heavier than the ordinary solution in the cell. If afterward, the battery is charged again, very little zinc is found on the upper part of the cell and, of course, the deposition of zinc is carried on very irregularly over the whole surface of the plates. The maintenance of an automatic, good, reliable circulation of the liquid, is, according to the opinion of the writer, indispensable with a reliable working of this type of battery. Even with the lead accumulator, great success has followed that little wrinkle in relation to circulation. The rules, given for charging a Tudor battery, contain the following: "Each charging has to be carried to the end, until *large bubbles* of gas appear abundantly on the surface of the liquid."

In practice it will be found that it always takes 20 to 30 minutes from the beginning of the development of gas to reach that point, and the gas bubbles evolved set up such a strong circulation of the whole liquid in the vessel that it is mixed wonderfully well. This rule, followed up regularly, has most likely more influence on the life of the brown plates than the peculiarity of the construction of the plates, given a certain solidity of the lead support to begin with.

It seems to the writer, however, that the kind of circulation obtained by heating the vessels is not of the most reliable kind and that further progress could be made by applying proper devices for a good circulation, which must of course be simple, automatic and inexpensive.

Means for keeping out dust and the carbonic acid of the air are also pertinent with this type of battery. A layer of paraffin oil does not prevent the absorption of carbonic acid by the caustic potash. This may be easily seen by exposing to the air for some days a caustic solution, absolutely free from carbonates, and covered with a layer of half an inch of paraffin oil. There will not be much difference between this solution and another one of the same initial composition, but not covered at all by paraffin. Paraffin oil, like water, alcohol and a good many other bodies, also absorbs carbonic acid and, of course, gives it off to the caustic potash and absorbs again, and so on. The effect is as if the carbonic acid went right through the paraffin, and just as it would do with a porous diaphragm. As soon as the liquid has absorbed a certain quantity of carbonic acid, zinc is precipitated and eliminated in the form of basic carbonate of zinc. After a certain time, a decided decrease of the capacity of the cell will be noticed and it will be necessary to renew the electrolyte by a fresh alkaline solution of zinc. In this respect, only an airtight cover with a gas-valve will protect the liquid sufficiently.

The Resistance of the copper-zinc accumulator varies greatly with the temperature, much more so than that of a lead cell. It is quite considerable at temperatures near the freezing point and quite small at high temperatures. At 130 degs. the resistance is about double what it is with a lead accumulator of the same capacity in watt hours. The efficiency of the battery depends, of course, upon the resistance and is, therefore, highest at the very highest possible temperature. Since the resistance is made up of several components (resistance of the electrolyte, resistance between the zinc layer and its support, resistance between the porous copper and its supports, resistance caused by the porous partition, etc.), the above remarks are very general.

The Capacity depends also on the temperature of the cell. With the lead accumulator one may say that between temperatures of from 32 to 68 degs.,—the capacity of the cell being 100 at 68 degs.—for each degree downward the capacity diminishes ½ per cent. At 32 degs. F., the capacity is only about 80. Now, the same thing is true even to a greater degree in the case of the copper cell. There is good reason to believe, that this decrease of capacity depends main on the state of fluidity or viscosity of the electrolyte. One can imagine that the lower the temperature the thicker electrolyte becomes until at last it is solid; at this point, no capacity at all would be found in the cell.

THE WESTON TELEGRAPH RELAY.

The remarkable sensitiveness of the Weston voltmeter and its accuracy in determining small differences of potential has led the inventor, Mr. Edward Weston, to adapt it to telegraphic work, and a patent has recently been issued to him covering this novel application of a well-known device, slightly modified, as shown in the accompanying engravings. Here Fig. 1 shows the plan of the instrument, Fig. 2 is a sectional view, Fig. 3 shows the movable coil and Fig. 4 is a diagram of the circuit.

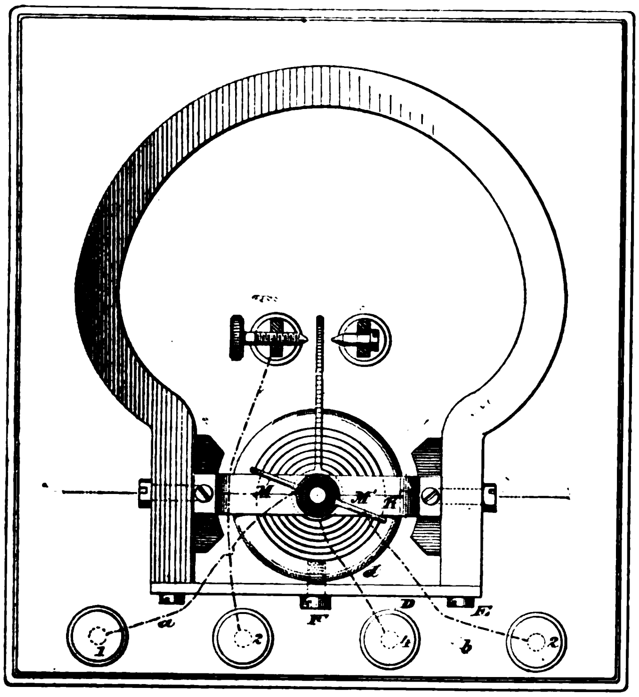
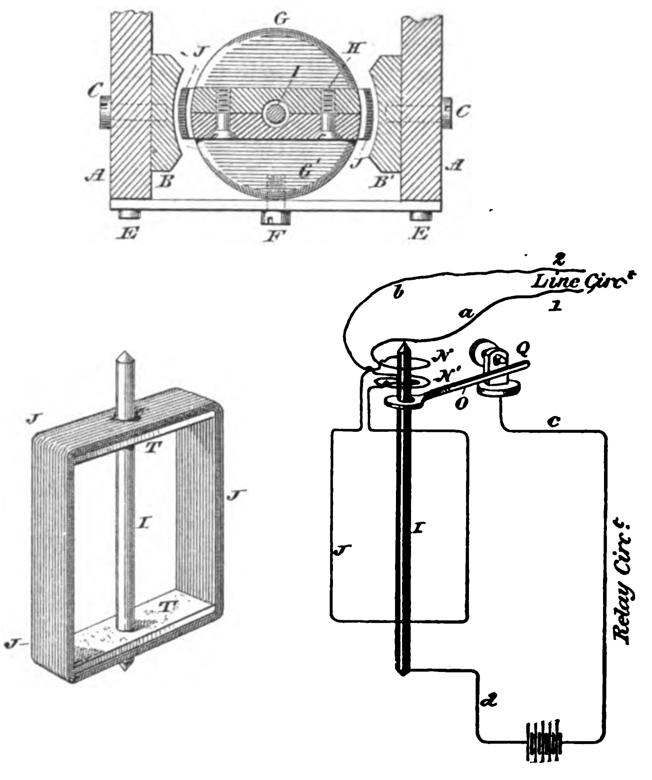


Fig. 1.—The Weston Telegraph Relay.

When the current comes over the line circuit, the coil J tends to set itself in a position transverse to the lines of force of the magnet A, and it therefore rotates on its pivots, and so moves the contact arm O into contact with the adjustable contact stop Q, thus establishing a local or relay circuit. While the movement of the coil depends as before upon potential difference, the extent of movement is not measured, nor is it material so long as it is sufficient to move the circuit-closing arm of the relay circuit into and out of contact with its stop. The main thing needed is great sensitiveness of the coil, so that it will respond instantly and quickly to any current, however small, which may pass through it. It, therefore, becomes important not to provide the coil with any means tending to retard or check its motion. It is also desirable to make the coil as light as possible, so that the retarding effect of its own inertia will be reduced. With these objects in view the coil, as represented in Fig. 3, consists of a helix wound upon two transverse bars T of paper or light metal, which are secured to the pivot shaft I. The vertical portions of the coil, therefore, which enter the field, are merely parallel strands of fine wire. The resistance of the coil to its impressed motion due to the current is, in this way, reduced to a minimum.



Figs. 2, 3 and 4.—The Weston Telegraph Relay.

The great advantage claimed for this instrument is the exceedingly small amount of current required for its operation. The measuring instruments of the same type are so extremely sensitive and accurate that, according to Mr. Weston, it is safe to say that this apparatus will work under a current strength of much less than one ten-thousandth of an ampere. According to Mr. Weston the new relay will permit the working of longer main lines with less battery power, and line conductors of smaller cross-section, coupled with greater certainty and accuracy of operation.

THE PAN-AMERICAN TELEGRAPH LINE.

A syndicate has been organized for the purpose of constructing a Pan-American telegraph line to extend along the Pacific coast from Victoria, British Columbia, to Santiago, Chili, passing through the United States, Mexico, the Central American States and the Pacific coast countries of South America.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.
United States and Canada, - - - - - - - - per annum, $3.00
Four or more Copies, in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York, N. Y., Post Office, April* 9, 1888.]

Vol. XVII. NEW YORK, FEBRUARY 21, 1894. No. 303.

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THE WASHINGTON CONVENTION.

As a place at which to hold a winter convention, it must be admitted by everybody that Washington is hard to surpass. At any time it has countless points of charm and interest, but when Congress is sitting and the whole atmosphere of the town is athrob with national politics and controversies, he is indeed a dull man whose pulse is not quickened on thus finding himself at the very heart of affairs, participating at will in historic scenes and shouldering celebrities at every turn.

The National Electric Light Association will meet in Washington next week, and the wisdom of the choice is already seen in the promise of an unusually large attendance. Not only is the National Legislature engaged with questions of the most vital importance, and debating them with an ability that certainly has not been excelled of late years, but the national electric light legislature has also a good many large topics for its earnest and careful consideration. The industry throughout is on the move, and the returning times of normal prosperity find it confronted with new issues. The industry to-day is freer than before. Never was the power of the parent companies less; never was the strength of the local companies acting together greater; never was there a fainter desire on the part of the supply houses to dictate, or even suggest, the lines upon which the Association should be run.

It is already known, as we have said, that the attendance will be large, but if any of our readers who ought to go are still undetermined, we urge them to make up their minds at once to the trip. These are still days of economy, but better times are near and the expense is so slight as to bear no relation to the good that can be derived for meeting old friends, making new, sizing up the situation, and imparting as well as receiving the cheer and encouragement with which to speed the arrival of the next long, solid era of prosperity.

EXTINGUISHING LIBERTY'S TORCH.

Once again it is proposed to quench the torch of the Bartholdi Statue of Liberty that stands so conspicuously at the entrance of New York Harbor, and faces the incoming stranger who has just braved the terrors of the Atlantic for the sake of a new home. The Secretary of the Treasury has virtually pronounced the light of Liberty a nuisance. The Lighthouse Board has informed him that the statue as a beacon is of no use whatever, standing on no range and being too far inland. Moreover the generating plant has run down, or been allowed to deteriorate, and the appropriations are insufficient for work really needed elsewhere. The secretary therefore wants the House of Representatives to order the extinction of the Statue as a beacon.

This strikes us as a rather lame and impotent conclusion to arrive at in view of the fact that the Statue is the gift of a friendly nation and can certainly be made ornamental should it perchance fall short of utility. New York has been rather unlucky in its attempts to get first class electric beacons. The tall tower at Hell Gate was abandoned because its light was too strong and now the Statue of Liberty is to be given up because its light is too weak. It appears that the cost of maintaining Liberty now is less than $10,000 a year. That ought not to tax the Lighthouse Department very severely; but if it does, we believe the Franco-Americans on each side of the Atlantic would raise enough money to create a fund for the work. Besides the lighting of Liberty might be improved both as to operation and as to the form of the light. It might be possible to light the Statue with current sent through a cable, and thus dispense with the island plant. It seems to us that the Statue itself has never been quite successfully handled. Why would not a couple of search lights be an improvement over the present method? Or perhaps the whole figure could be outlined. We have no definite plan in mind, but in conveying to our readers what seems to us to be a not very satisfactory piece of news, we suggest that in the rehabilitation of the Statue of Liberty as a beacon there may be both opportunity and glory for some of them.

REPARATION OR RECONSTRUCTION OF INCANDESCENT LAMPS.

Electrical litigation has served to establish or confirm more than one principle in law and the recent decision of the Circuit Court of Appeals in the case of the Edison Electric Light Co. (General Electric Co.) vs. the Davis Electrical Works, brings out a rule which has a wide bearings on apparatus involving devices subject to "combination" claims. Considering the second claim in the patent, the one in controversy, the Court takes the view that the only new element in the combination is the carbon filament; and that this in use in a vacuum represents the entire advance from the state of the art, so far as that claim is concerned. After reciting and discussing a number of previous decisions on the question of what constitutes *repair* as distinguished from *reconstruction* of patented mechanical devices, the court comments on the arguments and affidavits submitted and cites that of the appellants who argued that if the injunction were allowed to stand it would give the complainants the same benefit as though the patent contained a claim for the filament alone. While admitting this contention, and citing the Bell telephone claim as a case in point, the Court nevertheless holds that if the new element in a combination is associated in the claim with additional elements which, in the state of the art, there is no practical method of replacing by others, the patentee obtains the same practical advantages as though this new element had been claimed alone,—at least until the art makes new discoveries; but the patentee, it holds, ought not to be deprived of his just rights because under some circumstances he gets incidental advantages beyond what he expressly bargained for. But it seems that one of the principal affidavits presented by the defendants had an effect upon the judicial mind exactly opposite to that which it was intended to have. This affidavit likened the renewal of the filament in an incandescent lamp to the replacing of the wick in an oil lamp, and further compared the opening of the glass globe for the insertion of the filament to the removal of the glass chimney in order to facilitate the insertion of a new wick. The Court holds, contrarily, that so far from the filament being the mere wick, it is itself essentially the lamp, that is, the electric lamp of Edison. "In essence, the filament, duly charged, is the light-giving thing. It can give light without the glass receiver or the vacuum, though it does it better and longer with them." On these and other grounds the Court holds that the injunction issued from the Court below must be allowed to stand and thus the question of incandescent lamp repairing would appear to be for the time being determined, so far as the District of Massachusetts is concerned. We have an idea that the question of the repair, even reconstruction, of patented devices is barely settled yet. Probably nearly all the electric light and electric railway companies in the country to-day are repairing and reconstructing, frequently, patented devices that compare broadly with the lamp. Some of us remember the time when the old parent companies insisted on doing all the repairs at terrific prices. They don't now.

THE AMERICAN GONDOLA.

One of our articles this week illustrates and describes the successful appearance of an American electric launch upon the waters of the Adriatic, at Venice. The launch was taken from the World's Fair lagoons after successful service and lots of hard work, and carried to Venice, where its operation has been witnessed with intense interest by the whole population, which has a most natural curiosity to see how the new comer can compete with the historic gondola. The scene depicted in our illustration, showing the launch on the Grand Canal, off the Doge's Palace, is full of suggestiveness, and we can readily imagine that many a poor gondolier fears to find his occupation gone. It is the intention, we are informed, to put a number of these launches on the canals of Venice. No objection can be raised to them, even on the score of uncomeliness, for as they are now, without any pretence at special splendor, the launches have fine, graceful lines and they can, if necessary, be made in the shape of gondolas, just as the first railway carriages simulated in their curves the outlines of the old stage coaches. Moreover, the gondolier, whose present task is a hard one, can obtain much easier employment, if he will, handling a launch with a few turns of the wrist.

In this country, it may be said, the future of the electric launch is now well assured, both by the brilliant demonstrations of a practical nature at the World's Fair, and by the intelligent interest now being taken in them by some of our wealthiest amateurs. A new thing sustains no harm by having fashion enlisted in its behalf. Naphtha launches have been a most deserved success, and there are now a great many afloat, with the likelihood of more to come; but our conviction is strong that the electric launch is destined to be par excellence the American gondola.

MYSTERIOUS ELECTRIC LIGHT FIRES.

The "drive" which the Fire Underwriters of New York have recently been making on electric lighting and electric railways, as a cover for an excuse to raise insurance rates, will probably lead to no more results than have similar attempts in the past. The desperate character of the latest attempt, is shown by the fact that an increased rate is put on buildings wired for electric lighting, *whether current be used in the building or not.* In other words, owners of buildings are fined for preparing to use the current at some future time. Electric lighting has had to contend with many difficulties and has passed through more than one crisis, and we have no fear that it will suffer permanent injury in the present instance. But while inveighing so strongly against a maximum 220 volts, the Underwriters seem to have lost sight entirely of a service which has existed for years, and which in their blind antipathy to electric lighting seems to have been left entirely unmolested. We refer to the stock ticker and news quotation service, the circuits of which enter hundreds of buildings. These systems are operated at a potential of about 300 volts alternating, and when breakdowns occur two circuits are coupled and the potential run up as high even as 600 volts. The insulation of these lines has never been put forth as a model in its way; on the contrary, we have known instances where these circuits have been used as a convenient "ground." Is it any wonder, therefore, that we frequently hear of *mysterious* fires due to electric light wires? It would be interesting to know the number of buildings in which mysterious "electric light" fires have occurred which were also provided with stock tickers, and we commend this subject to the attention of the New York Fire Underwriters. If they propose to be severe, let them be severe with justice and discretion.

ELECTRIC TRANSPORTATION DEPARTMENT.

ELECTRIC LAUNCHES ON THE CANALS OF VENICE.

The success of the electric launches on the lagoons of the World's Fair at Chicago was so marked that the idea of trying the same boats on the lagoons and canals of Venice at once suggested itself. The result was that one of the launches which had been in service at Jackson Park from the early spring was shipped last September to Venice, her motor and batteries being removed from the hull for the Atlantic voyage. Arrived at destination, the various parts were all reassembled, and under the fitting name of "Venezia" the little craft made her first appearance in the waters so long monopolized by the song and oar of Adria's gondolier. It is needless to say that she created a sensation, for her quiet and graceful performance, so different from the noisy, fussy movements of the steam launch, gave immediate proof that in the electric boat the time-honored gondolier had at last met a rival against which no halo of poetry and romance would help it greatly. Our picture of the "Venezia" was made recently as she lay in the waters of the Grand Canal right opposite the Doge's Palace. Mr. R. N. Chamberlain, whose intelligent engineering supervision did so much to render the boats a success at the Fair, where they carried 800,000 passengers proceeded to Venice as soon as he could be spared from Chicago, and had the boat fixed up in good shape. She now has 68 cells in 4 groups, governed by a mechanical controller. In order to protect her hull against the weeds and action of the canal water, her hull has been sheathed with copper. The success of the boat is indubitable, but we understand that the fleet of which she is the prototype will all be longer, so as to afford greater passenger capacity. Visitors to the World's Fair will note that her deck housing is slightly changed, it being now made to conform to the general style of the quaint cabin-top seen on the gondolas, in Venice, but not very much in evidence on the gondolas used at Chicago.

The American Electric Launch "Venezia," on the Grand Canal, Venice.

THE MAGNETIC ELECTRIC RAILWAY—AN UNDERGROUND CLOSED CONDUIT SYSTEM.

The many objections offered to the overhead construction required for the present trolley system of electric street railways, have induced inventors to try to evolve some system of electric propulsion which would eliminate the objectionable features of the overhead wires, by using some kind of underground conduit, from which the current could be conveyed to the motors on the car. Many different systems have been tried with varying success and we have illustrated them in our columns from time to time. We now take pleasure in presenting to our readers for the first time, an illustrated description of the closed conduit system of the Magnetic Electric Railway Company, of Salem, Mass., which has been attracting a great deal of attention from electricians for the past few months,—a system in which the conduit laid along the street between the car rails is entirely dead, except at the moment when a car is directly over any one section. The two engravings shown herewith illustrate the method of construction, one showing a longitudinal and the other a transverse section, through the conduit.

The construction is extremely simple and consists of a series of brass pipes or tubes A A, about ⅜ of an inch thick, laid in the street, between the rails, only the upper surface of the pipe being exposed.

Each pipe is filled with a core of wood or other insulating material shown clearly in the sectional view, with a slot running lengthwise of the pipe about one inch wide and two inches deep. In this slot are two steel rods C C about one-fourth of an inch in diameter lying loosely and so connected to a flexible wire, D D, as to allow the rod free play up and down in the slot.

These flexible wires are connected through each end of the brass pipe, which is hermetically sealed, with the main line wire

F F or substitute for the trolley wire. This line wire is in a conduit with the feed wires buried in the ground, more easily seen in the sectional view, Fig. 1. The steel rods are thus connected with the main line. The pipes are about 10 feet in length and laid with intervening spaces of about six feet.

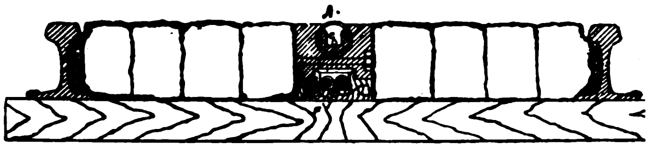


Fig. 1.—The Magnetic Electric Railway.—Transverse Section.

Underneath the car, which is equipped with the ordinary motors, are two magnets M M, Fig. 2, and two metal contact brushes E E, the brushes being placed close to the magnet and nearer the ends of the car. When the magnet under the car comes over the brass pipes, the rods in the pipe are instantly drawn up to the inner surface of the pipe and the pipe is thus connected with and becomes a part of the main line. The current then passes through the contact brushes to the motor. The distances between the magnets and the intervals between the brass pipes are so arranged that before the rear magnet and brush have left the section the front magnet and brush are over the next section so that there is a continuous current through the motor. The moment the magnet has passed by any section of the pipe, the rods drop down to the bottom of the slot and the brass pipes become dead and harmless, so that no section of pipe is alive except when under the car. Injury to any one of the pipes or sections does not affect any other section, or delay the car.

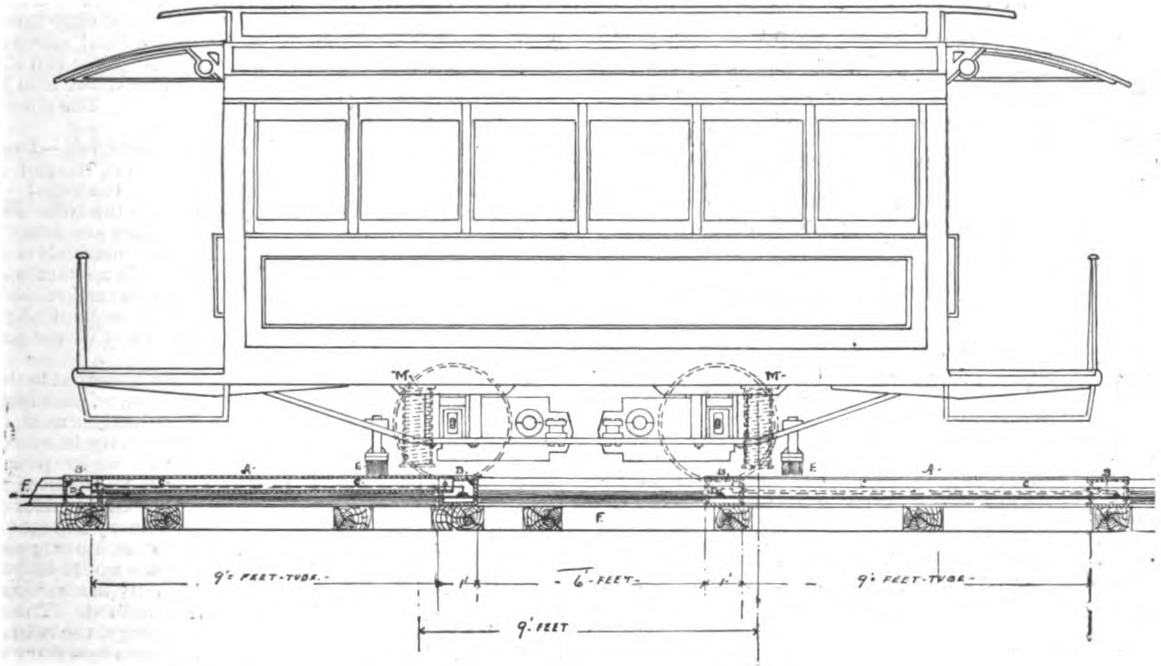


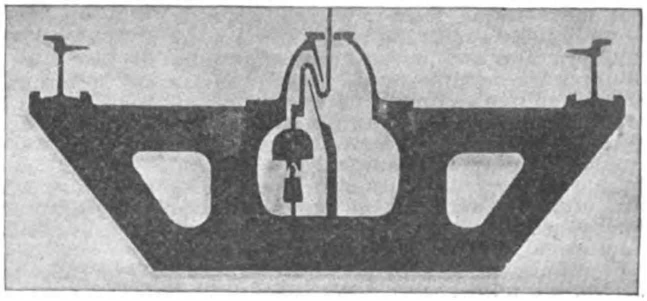
Fig. 2.—The Magnetic Electric Railway.—Longitudinal Section.

The experimental section at present laid down at Salem, although somewhat crude, has stood the test of all kinds of weather, and every electrical engineer who has seen it, has spoken in most marked terms of praise. There is no doubt that it does its work, and the car runs as smoothly and with as much certainty as if it depended upon its current from the conventional trolley. There can be no danger to horses by this system as no section of the pipe is alive, except the one immediately under a car. The brass pipe, which comes a little above the surface has been calculated to stand the hammering of the heaviest traffic and will last for years. The construction may be of the most substantial kind, the pipe being imbedded in cement, laid on top of the conduit containing the feeder wires, or between supporting steel flanges if preferred. No expensive foundation work is required, as is necessary where an open conduit is used, but the whole structure can be laid on top of the regular street railway cross ties.

The system is the invention of Mr. Edward H. Brown, of Salem, a young lawyer of that city, and the details have been worked out under the supervision of Mr. Mark Loud, the electrician of the company, and Mr. M. H. Ballou, consulting engineer for the company. Mr. Loud has spent much of his time in developing the electrical features of the system, and Mr. Ballou who is an electrical engineer of some 10 years' standing, has brought to the system much valuable experience in electric railway work, and has worked out the mechanical details for actual service construction. The company is a strong one, and is composed of the following officers and directors: L. G. Burnham, Boston, president; C. E. Hubbard, Boston, treasurer; Henry W. Peabody, Boston; F. Lincoln, New York; B. W. Russell, J. N. Peterson, A. F. Huntington, Charles Sanders, J. H. Poor and Edward H. Brown, directors.

THE GRIFFIN ELECTRIC RAILWAY CONDUIT.

Among the railway conduit systems recently brought forward that known as the Griffin system appears to be well worthy of consideration and study. By reference to the accompanying engraving it will be seen that the prominent feature of this system consists in the entire separation of the electrical from the drainage system. Beginning with the mechanical construction, it will be noted that the system embodies a slot in the roadbed and employs yokes, similar to those used in cable systems; but with this difference, namely, that the yokes are so small that they are sufficiently strong and rigid to act as the foundation of the complete structure without bracing. The conduit yokes are only 20 inches deep and 18 inches wide on the inside, which is ample for drainage, and they evidently occupy much less space than the cable conduit. The total depth of yoke, 26 inches brings it above the level of gas and water main so that the cost of laying is correspondingly diminished.



The Griffin Conduit Railway System.

The device for insuring that all surface water be kept out of the section where the wires and insulators are fixed will be seen to consist of an apron overhanging the electrical section of the conduit and running its whole length. A double curved arm bearing the trolley or contact device is connected to the car and presents no structural difficulties whatever. Manholes and hand holes placed at suitable intervals allow of ready inspection and repair.

While the apron insures dryness of the electrical section of the conduit and thus would, of itself, secure high insulation of the conductor even with the usual forms of insulators, additional insulation could be secured in the Griffin conduit by introducing an oil insulator which, it is estimated would give an insulation resistance of 10 megohms per mile with insulators only 25 feet apart. The leakage would therefore be practically reduced to nothing and with it also the deterioration of the structure from electrolytic action.

The trolley wheel and its insulated protector is so arranged that it is impossible for it to jump from the conductor and thus prevents the production of arcs which would soon wear out the contact device. The conductors being placed below the surface of the earth and not in contact with any overhead conductors, it goes without saying that immunity from lightning is insured.

A model of the Griffin system can be seen at the offices of the Electrical Conduit Traction Equipment Company, in this city, who are exploiting the system.

ELECTRIC CANAL BOAT PROPULSION WITH SPECIAL REFERENCE TO THE ERIE CANAL.[1]

BY JOSEPH SACHS.

ELECTRICITY has been suggested at various times as a source of energy for the propulsion of canal boats, but has never been brought to any such degree of prominence as within the last two or three years. The method as generally proposed and which was tried on the Erie Canal near Rochester during the latter part of 1893 consists in placing an electric motor upon the canal boat which revolves a screw propeller at the stern. This electric motor receives its current from suitable overhead wires through a flexible contact arrangement. There certainly is no doubt in regard to the successful mechanical operation of such a combination, but this method is not the only, and certainly not the most feasible and economical plan of operating canal boats.

There are in fact five other methods (six with propeller) of propelling boats in shallow and narrow bodies of water. They may be divided as follows:

1. Propellers. 2. Flexible submerged cable towing system (similar to European methods). 3. Rigid rail towing or hauling (exterior). 4. Rigid rail towing or hauling (submerged). 5. Movable cable. 6. Motor locomotive haulage.

The requirements for the successful system may be enumerated as follows: It is particularly necessary to deepen the Erie canal, as with the present depth of hardly 7 ft. the present maximum speed of 2½ miles per hour can hardly be maintained. Inasmuch as the successful method must attain at least 3 miles per hour, if not more, the canal must first be deepened. The method of propulsion must not injure the canal structure. It should appeal to the boatman as a better and cheaper method. The chance of breakdown of propelling machinery should be reduced to a minimum. It should enable the present methods of propulsion to be continued. Any structure erected should be strong and not easily disabled. The system should require as little machinery as possible upon the canal boat. The source of current supply should be constant.

Class I, Propeller.—Although this method would include all boat propellers such as paddle wheel, jet or screw, it has been found that the screw is the most feasible.

There are three methods of applying the screw to canal boat propulsion. 1. By placing the motor and screw directly upon the canal boat. 2. By the use of separate propelling tugs that carry no freight. 3. By the use of a false or detachable stern which holds the motor and screw. With any of the above methods it is necessary to have some source of current supply. The most generally proposed and practical method consists in suspending a wire or wires over the canal. As the canal cannot be used as a return circuit two wires are necessary for boats going in each direction (four wires for both). Arrangements must also be made to permit the boat to move laterally and therefore some form of flexible trolley carriage must be used. The most feasible plan of applying the screw will be some form of separate tug or false stern as by such arrangement various objections to placing the motor directly on the boat are obviated. Such methods will also be somewhat more efficient.

Objections to any propeller methods are: 1. Low efficiency of screw propulsion, and large operating expense. 2. Equipment of boats with motors. 3. Injury to structure by wash.

The effective energy to move a certain boat at a certain speed through a body of water is the same, no matter how the boat is propelled. The method of accomplishing this with the least loss above the effective power necessary is certainly the most efficient. In some sort of direct pulling or hauling system this loss will certainly be less than with the screw.

Class No. 2.—Submerged Cable.—The method consists in laying at the bottom of the canal a chain or cable which is raised and passed over rollers or friction drums on the propelling or towing boat which firmly grasp the cable or chain and by rotating pull the boat along the canal. This system is extensively used in Europe. A separate towing boat is used with suitable engine and boiler and the machinery necessary to pull on the cable or chain. In 1875 such a system was tried on the Erie but found to be unsuccessful. The electric motor can readily be substituted for the engine and boiler in such systems and current can be supplied, in a similar fashion to that used in the previous method. Instead of using two wires, one would only be necessary for each direction as the cable could be used as the return. As the motor takes up much less room than the engine and boiler a separate towing boat would perhaps not be necessary as in the European systems, but the motor and machinery could either be placed directly on the boat or upon a detachable platform as suggested by a German engineer. Such methods would not be successful on the Erie. Suffice it to say that it has been tried and found wanting. The principal objections are the slipping of the chain or cable, the large amount of slack chain each boat must take up and the necessity of dropping and taking up the cable a great number of times caused by the many locks on the Erie.

Class 3, Pulling on Rigid Rail (Exterior).—This method consists of a rigid rail or rack adjacent to the canal and parallel thereto. A motor is placed on the boat and rotates suitable rollers or pinions which engage the rail or rack and extend from the boat upon arms. The current is furnished by similar means to those in the previous cable methods but the lateral movement of the boat is obviated. The structure supporting the rail also supports the wire. Such a method is quite practical but also has some of the objections of the former cable method. The efficiency of the two are very nearly alike.

Class 4, Pulling of Rigid Rail (Submerged).—This method is the reverse of the above. Instead of placing the rail adjacent to the waterway it is laid at the bottom of the canal. A motor is placed on the propelling boat and rotates the roller engaging the rail or rack. The shaft to which the rollers are attached extends through the bottom of the boat. In such methods it is necessary to have a separate propelling boat. A single contact wire arrangement can be used as in either of the previous rail or cable methods. Such a method would no doubt operate mechanically but would be very costly and no more efficient than any of the previous pulling methods.

Class 5, Moving Cable.—This method is similar to the operation of an ordinary cable road with the difference, that instead of the cable pulling cars it is connected with the canal boats. The general plan would be to generate electricity in one or two very large central generating stations where water power could be procured and distributed at high pressure to electric cable operating stations located along the route of the canal. Here large electric motors would operate the cable machinery and move the cable. An arm would extend from the boat to the moving cable and by use of suitable gripping devices the boats would be pulled along. The boat would actually be moved wholly mechanically but the system as a whole would be an electric method. The various losses in the many transformations of energy, the operation of the long cable, the many cable power plants necessary and the extremely large cost and complicated mechanism would appear to make this method somewhat impractical.

Class 6, Motor Locomotive Haulage.—This method is really an elaboration of the old and primitive mule method, but instead of the slow and uneconomical animal a more rapid, efficient, electromechanical mule is substituted. It consists in running an electric motor parallel to the canal upon a suitable structure or track and receiving current from contact wires adjacent thereto. This motor locomotive is connected with the boat by suitable means and hauls the same by being propelled along the track or structure. Such electric locomotives may be large and heavy and be controlled by a motorman directly thereon and haul a train of boats necessitating a large, heavy and strong structure of track; or they may be small and run upon a light structure, each motor being attached to a single boat and the motor on the structure regulated from the boat. The first method would necessitate the location of tracks on each side of the canal and would interfere with the present methods and be very costly and perhaps somewhat impractical.

The author believed in the latter method will be found a solution of the electric canal boat propulsion problem. A light, strong structure can be erected along the canal in such manner as not to interfere with the present methods. Upon this support, small electric motors are adapted to be propelled in either direction by a current received from wires supported on the structure. The boat in the canal is connected with the motor by a tow line and the motor is started, stopped and regulated from the boat.

Although the boats may be coupled each boat is pulled by a separate motor thereby permitting the erection of a light, small structure only strong enough to stand the strain of one boat. All the motors are regulated from one source on the first boat. Devices are arranged for switching and passing of the boats and special arrangements for furnishing current and gripping the rail are used. The motors for both directions may be operated on one or both banks of the canal or suspended overhead.

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[1] Abstract of a lecture delivered before the New York Electrical Society, Feb. 15, 1894.

The main features of such a method are: 1. The boats are not changed. 2. Any other method may also be used. 3. Economy of operation. 4. No damage to canal structure. 5. No machinery on boat. 6. Chance of being stalled reduced to a minimum.

The method of haulage last described is certainly very feasible, and perhaps the most practical of the various haulage systems described. As compared with a screw propeller method it is very much more efficient and has none of its disadvantages. A saving of over 15 per cent. can be shown over the operation of the propeller method. This is taking into consideration the cost of plant, interest, coal, maintenance, labor etc.

To operate 600 boats constantly moving on the Erie Canal (300 going each way) at three miles per hour in 8 ft. of water and allowing a constant operation at this rate for 220 days the trolley propeller plant would cost $4,500,000, and operating expenses would amount to about $800,000 for that period.

To operate the same number of boats by the hauling method the first cost of plant would be $5,550,000 and cost of operation about $680,000.

If the electric propelling system is installed and maintained by the State and we do not consider interest on plant, a much greater saving can be shown, in favor of the hauling method. With a properly installed plant, on this basis, from 30–50 per cent. can be saved over the present steam method.

It will be seen that although the first cost is greater in the latter method the operation of boats per boat-mile would be less. Aside from this fact however, the latter method has so many advantages over the propeller that some form thereof will no doubt be the future method of operating canal boats.

MISCELLANEOUS.

ESSENTIAL STATION INSTRUMENTS.[1]

BY PROF. D. C. JACKSON.

The term, station instruments, may be made to cover a variety of tools and indicating devices from the coal shovel to the main fuse block.

A great many of the fires in electric stations start at the switchboard. This can be made almost absolutely safe, and with proper construction switchboard fires should be almost unknown. Build your switchboards of non combustible material. Marble is not very expensive, and is better than slate. If combustible material is used for the board, never make it solid, but arrange it simply as a skeleton upon which the instruments may be secured. Set the switchboard at least two feet (three feet is better) from the wall, and have all the wiring done in the best possible manner and in plain sight. Under no circumstances close the ends of the space back of the board, making it into a sort of rubbish closet.

The switchboard should be located conveniently, and the instruments conveniently placed thereon. The dynamo instruments should be bunched together, and the different devices belonging to each individual dynamo circuit should be placed in vertical rows. Pressure indicators, cutting-in galvanometers, ground detectors, and other instruments which are common to all the dynamos should be placed where they are easily seen by a man at the dynamo regulators. Devices placed in the feeder circuits may be placed either above or at one side of the dynamo instruments. In any case the arrangement should be such that extensions may be easily made.

The number of instruments on the dynamo and feeder circuits should never be multiplied unnecessarily. Their type and number in any case depends upon the type of the apparatus and the purpose for which they are used. If arc light dynamos with separate regulators or controllers are used, these should be solidly mounted near the dynamos to which they belong. In each case the maximum of safety and convenience should be sought in the arrangement of the instruments. The arrangement of the standard panel switchboards of two or three prominent manufacturing companies may be followed with profit. Where two or more classes of machinery are used. the different types of dynamos should be set together, and the switchboards should be distinct, but side by side.

Let us drop the electrical question now and go over to the steam side. The first instrument on this list is a platform scale for weighing in the coal. Daily records of coal consumed should be carefully kept and compared with records of the electrical output day by day, week by week and month by month.

The coal shovel is a very essential instrument which requires a great deal of careful supervision. The coal records and automatic records of steam pressure serve this purpose. An automatic steam pressure recorder is not an expensive instrument. If one is properly installed and its indications are acted upon by the manager, it will soon save its cost. Thermometers in the feed water pipe and in the steam pipe are not essential to the operation of a station, but they are certainly advantageous. A throttling calorimeter made up of ordinary fittings is also serviceable. They are not kid-glove affairs, but good common sense appliances. Steam gauges on the boilers are essential, but it is not usual to put one in the steam-pipe near the engine. It is a good idea, however. Five to ten per cent. of the fuel used on day load makes a considerable item in the period of a year, which will pay for the recording boiler gauge and a gauge in the engine pipe, besides adding a sum to the dividend account. It is true that the gauge in the engine pipe does not remove the fireman's impulse to reduce pressure by throttling, but if his work is constantly under inspection, the impulse is much less likely to be irresistible. In this connection, let me remark regarding the usual practice of cutting off the condenser at times of light load when condensing engines are used. Under such circumstances, fuel is saved by keeping the condenser running, but reducing the boiler pressure to hold the engine cut off at an economical point.

Another instrument of much use is the engine indicator. This is particularly useful in determining whether the engines are working at their most economical cut-off and whether the valves are properly set. If cards are taken at fixed intervals and filed for reference, they may be made a decided aid in the effort to keep everything at the most economical point.

I have spoken particularly of instruments that are frequently not used in the stations, but which can be made of much valuable assistance in reducing expenses. These are not varnished theoretical ideas, but hard common sense dividend earning suggestions. They can be put into service without increasing the operating costs in any way, and the instruments will ordinarily quickly pay for themselves.

THE LATEST THINGS IN ELECTRICITY.[2]

The author first drew attention to the difference in the conditions existing now and ten years ago in the prices of materials and the gullibility of central station managers. He next referred to a new wire the insulation of which consists of cotton just as it comes from the gin saturated with a high grade of insulating compound. Regarding transformers, he spoke of the newer types embodying the designs which obviated the necessity of oil insulation and had the fuse-wires accessibe for renewal in case of a blow out. Great progress had also been made in high candle power incandescent lamps; lamps of 500 and 1,000 c. p. now being available burning at from 2½ to 2¾ watts per c. p. Reference was also made to the improved alternating arc lamps and to Mr. Tesla's work in high frequency lighting.

THE ACTION OF ELECTROMAGNETIC RADIATION ON FILMS CONTAINING METALLIC POWDERS.[3]

After noticing the resemblance of the phenomena exhibited by tubes containing metallic filings shown by Mr. Croft on October 27th, to those of photoelectric impulsion cells, he described films of gelatine and collodion containing metallic powders. Directions for preparing the films are given in the paper. On inserting such a film in circuit with a battery, key and galvanometer it acts as an insulator. To render a small portion conducting, the electrodes on the surface of the film are brought very close together, and one of the wires touched with an electrified body. (An electric gas lighter was often used.) This caused a current to pass. The electrodes may then be separated a little further and the process repeated until any desired portion is rendered conducting. The peculiarity of such a film is that, if the circuit be broken at the film, the film becomes an insulator, whereas breaking the circuit at any other point leaves the film conducting.

A short discussion followed, and Prof. Minchin, in his reply, maintained that the phenomena were due to electric impulses.

THE ELECTRICAL PRODUCTION OF PARA-AMIDO-PHENOL SULPHONIC ACID.

Hitherto para-amido-phenol which is used in photography and in the manufacture of dye-stuffs has commonly been prepared by the action or reducing agents on para-nitro-phenol. Recently, however, Messrs. A. A. Noyes and A. A. Clement, of Boston, have discovered that para-amido-phenol-sulphonic acid can be made by electrolyzing a sulphuric acid solution of nitrobenzol and have secured a patent upon their process.

One part by weight of nitro-benzol is dissolved in four parts of concentrated sulphuric acid, and this solution is submitted to electrolysis. Platinum is used for the positive electrode and cast iron for the negative electrode. The positive electrode is placed within a porous cup nearly filled with concentrated sulphuric acid and this cup and the negative electrode are placed in the vessel containing the sulphuric acid solution of the nitro-benzol, the purpose of the porous cup being to protect the reduction products of the nitro-benzol from the action of the oxygen set free at the positive electrode. An electric current of such strength is passed through the solution that its temperature is maintained at 90° to 100° centigrade without application of external heat, and the action of the current is continued until a portion of the solution no longer precipitates an oil (unchanged nitro-benzol) on dilution with water. After the electrolysis is completed, water is added to the product and the liquid is filtered. The solid collected on the filter is washed with water and treated with a solution of caustic soda or other alkali, by which operation the para-amido-phenol-sulphonic acid is dissolved out as a sodium salt. The sulphonic acid itself is precipitated from this solution by neutralizing with hydrochloric acid; it is then washed with water, and dried; or, if desired, it can be further purified by dissolving it again in alkali and reprecipitating it with acid.

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[1] Abstract of a Paper read before the Northwestern Electrical Association, Milwaukee, January 17, 1894.

[2] Abstract of paper read before the Northwestern Electric Association, by W. W. Low.

[3] Abstract of a paper by Prof. G. A. Minchin before the London Physical Society.

AFRICAN TELEGRAPH LINES.[1]

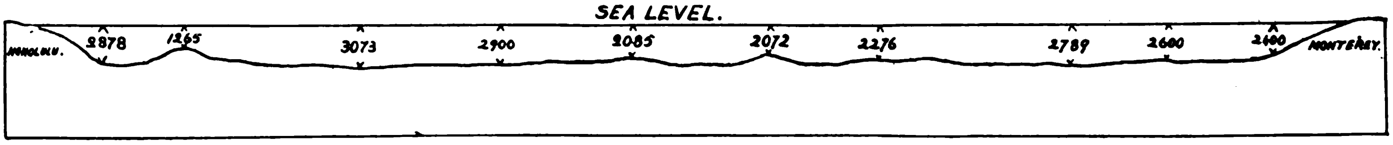
THE Congo State has decided to construct a telegraph line, fifteen hundred miles up the Congo River to Kasongo, and then two hundred and fifty miles east to Lake Tanganyika. The line is now building at its western end, along the track of the Congo Railroad. Perhaps ten years will elapse before the telegraph station is built on the borders of the lake. By that time the Germans and the British will have carried out their plan to join the east coast by wire with Tanganyika and Victoria Nyanza.

There is nothing visionary, to-day, about such schemes as these. Twelve years ago Stanley's idea of a telegraph line to Uganda was condemned as chimerical, but to-day a hard-headed capitalist like Cecil Rhodes pins his faith to the practicability of an inland telegraph line from South Africa to Cairo. The wire already stretches from Cape Town four-fifths of the way to the Zambesi. From the delta of that river messages are flashed more than half the way to Lake Nyassa. No obstacle has yet appeared that cannot be overcome.

The development of the telegraph service in Africa will come gradually, and it will be of immense advantage to the various enterprises there. Egypt, among the civilized lands, bids fair to profit most; for the day is surely coming when she will be notified many weeks in advance of the amount of the Nile floods that are on the way, and these statistics and warnings will be of the greatest practical value to the densely populated lower valley of the Nile.

THE BED OF THE PROPOSED PACIFIC CABLE.

THE *Hawaiian Gazette* recently published an interesting article on the proposed cable between the United States and Hawaii, giving a résumé of the work that has been done in this direction, and a profile, which we reproduce, of the last survey made. This route, considered by far the most suitable for the purpose, was surveyed by the U. S. S. Albatross, and extends from Diamond Head, Honolulu, to Salinas on the shore of Monterey Bay, California.



PROFILE OF THE BED OF THE PROPOSED PACIFIC CABLE.

There a submarine valley has been discovered, commencing at the mouth of what was formerly the Salinas river, and running westerly at the bottom of the sea, for a few miles, furnishing a most remarkable artificial bed for laying a cable. The entire absence of rocks, and the presence of deep soft mud and sand throughout this valley seems to have prepared it for this special service of a telegraph cable. The interesting report made by Lieut. Clover of the Albatross, who had command of this last expedition, shows that for the entire distance from the California shore to the terminus near Diamond Head, the ocean's bed on this route is destitute of rocks of any kind, while the bed for the most part consists of soft ooze and mud into which a cable will sink probably several feet and be entirely submerged and protected against marine insects and any obstacles which might tend to harm it if lying on the surface of the ocean floor.

Lieut. Clover's report says that this survey "was prosecuted with all the care and accuracy that the means for modern deep sea research afford, and it is believed that the maps and observations present a good knowledge of the route and establish the fact that the laying of a cable on almost any line between California and the Hawaiian Islands is practicable. A lane about 300 miles wide was developed between California and Hawaii, and the results seems to indicate the most favorable route to be a rhumb line between Monterey Bay, Cal., and Honolulu. This route has been determined upon as the most practicable, since it is the one that will require a minimum length of cable in passing over an even bottom consisting of soil which is favorable for its protection and preservation, avoiding submarine mountains and volcanic regions where substances exercising an injurious chemical action on the covering of the cable are likely to exist and where future convulsions may cause its destruction."

The distance from Hawaii to Vancouver, including the slack, is 2675 miles; from Hawaii to San Francisco, including the slack, it is 2247 miles. This latter route is therefore shorter by 428 miles and as the cable, when laid, is estimated to cost $1200 a mile, the latter route can be laid for $510,000 less than the Vancouver route. On the same estimate, the cost of laying a cable from Hawaii to Monterey Bay will be $2,696,400.

THE TREND OF ELECTRICAL INVESTMENT.[1]

BY H. C. THOM.

Eighty per cent. of the people who grumble at the monthly bill have been given service at such a rate as to entail a loss upon the company they patronize. How long can this continue? Men who have kept steady in faith for years will falter by and by. Stock will be sold for what it will bring and the weary burden laid down. Electrical development must suffer if holders of stock are too often pinched.

Electricity is a quick friend, an obedient servant and an insidious power for good or evil. Good if well managed; evil if guided by ignorance. If generated for less than seventeen per cent. net profit (10 per cent. for depreciation, and 7 per cent. on the investment), it will ruin homes and devastate the fertile field of research and progress. Electrical investigation has called out the highest talent known to the mechanical and inventive world. Let this talent be seconded by the same type of business sagacity, and progress will be unrestricted and the confidence of capital will be restored. The public is willing to pay living rates. At the same time corporations have no moral right to so conduct business that the effect of ignorance and mismanagement falls upon our necessary friend the customer. I most earnestly trust that this paper will start a movement which looks toward the establishment of rates that will be just to the public and remunerative to corporations; that will strengthen the heart of the student; encourage research and secure the eternal friendship of the capitalist.

HOUSTON & KENNELLY.

It will doubtless surprise many of our readers to learn that two gentlemen well known in the electrical field have determined to sever the connections they have held so long in their respective vocations. We allude to Edwin J. Houston, Professor of Physical Geography and Natural Philosophy in the Central High School of Philadelphia, who has held this chair for the past twenty-six years and who has just resigned; and to Mr. A. E. Kennelly, who during the past six years has been Mr. Edison's right hand man and chief electrician and who is about to leave the Edison laboratory.

We are glad to inform our readers that these gentlemen have decided to establish in Philadelphia a firm of electrical experts to be known as Houston & Kennelly. It is not necessary to remind our readers that Prof. Houston is President and Mr. Kennelly one of the Vice-Presidents of the American Institute of Electrical Engineers, in whose work they have taken the liveliest interest.

THE BOYNTON BICYCLE ROAD.—Messrs. Gillies and McEchen, of Sydney, Nova Scotia, solicitors for the applicants, announce that they will apply to the Canadian Parliament for an act to incorporate a company under the name of the Boynton Bicycle Electric Railway Co., of Canada, to construct and operate a bicycle electric railway from the City of Winnipeg, Manitoba, to the Port of Louisbourg in the County of Cape Breton, Nova Scotia, and between any places within said points, with power to acquire, take and use water powers and to make contracts for supplying power to the said railway, also to construct and operate all works for said railway.

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1. New York *Sun*.

1. Abstract of a paper read before the Northwestern Electrical Association, January 18, 1894.

LETTERS TO THE EDITOR.

A SERVICE OF GOOD WILL FOR THE ELECTRICAL FRATERNITY.

KINDLY inform your readers that I will be very glad to oblige any one of them in such ways as may be by them desired, to make their attendance at the Convention of the National Electric Light Association, to be held in this city February 27th and 28th and March 1st, enjoyable. It may be especially serviceable to some to have arrangements made for hotel accommodations, for printing cards, circulars, etc., before their arrival. If so, I shall be glad to attend to these and similar matters for them, as an expression of my good faith. I should be addressed as follows:

ALLEN R. FOOTE,

Care the National Statistical Association, Washington Loan & Trust Company Building, Washington, D. C.

CHLORIDE ACCUMULATOR LITIGATION.

THE CONSOLIDATED ELECTRIC STORAGE COMPANY, controlling the Brush patents, knowing that in the "Chloride" accumulator manufactured by The Electric Storage Battery Company the defects heretofore developed in the various types of battery constructed on the principles covered by the Brush patents have been practically overcome, have finally found themselves in the position where they must either abandon the storage battery field, or claim that the Chloride system of storage did in some way infringe the Brush patents.

Not being able by a systematic circulation of such statements to deter purchasers of storage batteries from taking the Chloride battery in preference to the inferior batteries made by the Consolidated company and their licensees, they have finally instituted suit, the only object of which, we believe, is to frighten intending purchasers of batteries who are not familiar with the subject, by the idea that there may be some foundation for their claim of infringement, and thus delay as long as possible the time when the Chloride battery will be the only battery that purchasers requiring a satisfactory system of storage will accept.

Without intrenching upon the province of the court, or venturing to forecast its judgment, we are advised by the best of counsel, and the most eminent scientific experts in this country, after a most thorough examination of the state of the art, that we do not infringe the Brush or any other patents in the slightest degree. Among these experts are Professor Charles F. Chandler of Columbia College, New York; Professor George F. Barker of the University of Pennsylvania, and others, copies of whose opinions we will be glad to furnish to any who may be interested in reading them. We quote briefly from a joint report of Professors Chandler and Barker, as follows:

NEW YORK, December 6th, 1893.

W. W. GIBBS, ESQ.,
President Electric Storage Battery Co., Philadelphia, Pa.

DEAR SIR:—In reply to your inquiries as to whether your Chloride Accumulator itself or the process by which it is manufactured or the way in which it is used in any way infringes the Brush Secondary Battery Patents or any of them, we beg to make the following report:

Having been engaged as experts in the litigation between the Brush Electric Company, the Julien Electric Company and the Electrical Accumulator Company, we are quite familiar with the Brush patents and with the interpretation which has been put upon them by the Judges of the United States Circuit Court and the Circuit Court of Appeals. * * *

You construct a composite plate consisting of tablets of chloride of lead and chloride of zinc in a frame of metal. There is no active material in this composite plate nor is there any material ready to become active in a seconday battery. Nor is there any material which is absorptive in a secondary battery.

In fact, as far as any use of this composite plate in a secondary battery is concerned it is practically inoperative and worthless. Before any use can be made of this composite plate it must be exposed to a process of electrical disintegration, not in the bath or fluid of a secondary battery, but in a totally different bath in connection with plates of zinc. And only after this electrical disintegration is the plate of any use in a secondary battery. * * *

Our understanding of the Brush claims is confirmed by the language of Judge Shipman, which reads as follows:

"The mechanical application of a layer of lead oxide to each of two lead plates, before the plates are placed in the battery fluid, these coatings being at once active material and ready for the charging current, when immersed in the battery fluid, was, in general terms, the distinguishing feature of the Brush invention. * * * * These claims describe and necessarily refer to a secondary battery as heretofore defined; a plate or support which is insoluble in the liquid, mechanically supports the active material and electrically conducts the current of electricity through it; the specified active or absorptive material being oxides of lead which are primarily mechanically applied to the plates and in such state of minute division as to be at once capable of being charged without previous process of 'formation' by electrical disintegration."

In conclusion we are therefore of the opinion that your battery does not either in itself, in the process by which it is manufactured, or in its use infringe the claims of the Brush patents.

We are familiar with all the batteries that have been held to infringe the Brush patents, and in all of them, the distinguishing features of the Brush invention as set forth in the above quoted passages of the opinion of the Court of Appeals were clearly present.

No battery such as yours, has been held to be an infringement of the Brush patent, and from our understanding of the opinion of the court of last resort, the Circuit Court of Appeals, such conclusion would seem to be impossible.

(Signed) C. F. CHANDLER, Ph. D.,
G. F. BARKER, M. D.

A careful reading of these complete reports, we believe, will promptly convince any one informed on the subject, that there is no ground for any claim of infringement, and that the only hope and expectation of the Consolidated company is to temporarily injure the business of The Electric Storage Battery Company, which they have been endeavoring to do for many months past, by the circulation of false letters and statements.

We, therefore, propose to continue making and selling our battery, and shall protect and save harmless all users of the Chloride Accumulator.

W. W. GIBBS,
President.

PHILADELPHIA, PA., Feb. 14, 1894.

THE HENRY SPEED RECORDER FOR ELECTRIC CARS.

I HAVE read your editorial on the subject of speed indicators for motor cars in the ENGINEER of Feb. 7, and as I am probably one of the few who have tested the advantages of such an attachment I wish to endorse your views.

The Railway Commissioners of the State of New York have recently recommended that all motor cars be provided with an automatic governing device to prevent excessive and reckless speeds. The necessity for both of these appliances occurred to me at an early day and they are subject matters of my patent No. 345,845 of July 1886. In the development of the electric railway motor it was thought necessary to strip it of all superfluous mechanism; in doing so quite a number of theoretically advantageous refinements were dropped. Now that the motor as built will stand any form of neglect or abuse may we not safely turn back and gradually apply the good but probably more delicate features that were left on the way side during a rapid march.

There is great need of a law that would compel all railroad companies to put speed recorders on locomotives and motor cars. Such an appliance, which is within reach, would soon separate the reckless from careful drivers. As it is at present, when an accident accident occurs, the liability is determined by guess work.

J. C. HENRY.

WESTFIELD, N. J.

INFLUENCE OF COLD ON PHOSPHORESCENT TUBES.

IN regard to the interesting experiments of Prof. Dewar reported in your issue of January 31, on page 83, is not the ceasing of the phenomenon of phosphorescence with the intense cold due to the *condensation* of the attenuated vapors previously in the glass tubes? This would make the vacuum more nearly perfect, and it is well known that the Geissler-tube effects are not found if the tubes are completely exhausted. This fact is taken advantage of in the testing of incandescent lamps for vacuum. It may be that Prof. Dewar considers that his question, "What does this mean?" was clearly answered by him, but it puzzled me, and I venture to send you this thought.

MORGAN BROOKS.

MINNEAPOLIS, MINN., Feb. 10, 1894.

COLLEGE NOTES.

ELECTRICITY AT THE YOUNG MEN'S INSTITUTE, NEW YORK.

We are pleased to learn that the class in Electrical Engineering at the Young Men's Institute, Nos. 222 & 224 Bowery, is being largely attended this winter and that the interest of the young men in their work is steadily increasing. The Managers of the Institute are very progressive and over a year ago they started this course of instruction in connection with their other educational classes. Last winter the class was well attended, and this year its membership has increased, and the Managers of the Institute are well pleased with the amount and especially with the character of the work now being done.

The class is made up of men from electrical construction and manufacturing companies; engineers from central stations and isolated lighting plants; and also men from street railway and electric power stations. As would be expected this class of practical men is eager for practical instruction and the Institute has secured as instructor, Mr. R. H. Mansfield, Jr., who is connected with one of the largest electrical engineering companies of this city and is actively engaged in practical engineering work. In this year's course up to the present the fundamental principles of electricity and magnetism have been carefully explained and the application of these principles in the telegraph, telephone, dynamo electric machine, electrical transmission of energy and its transformation into light, heat and mechanical power, are now being discussed.

COLUMBIA COLLEGE UNIVERSITY EXTENSION LECTURES.

On Feb. 14, Prof. F. B. Croker delivered a lecture on "Electric Lighting" in the University Extension Course which was attended by a numerous audience. The lecture was accompanied by experiments on arc and incandescent lighting.

The lecture of Mr. Nikola Tesla on Electric Power, announced for Feb. 26, has been postponed. Due notice will be given of its delivery. No lecture in the course will be advanced to take its place.

LITERATURE.

Rules for Electricity-Works Management. By Albert Gay. London: 1894. Published by LIGHTNING. Pocket size.

This is a series of instructions intended for the government of those in charge of the various departments of an electric light station, and of the outside work connected therewith. The rules cover the following: Electricians in charge; meter inspectors; jointers and jointers' assistants; meter room attendants; wiring inspectors; electricians on mains; engine drivers; stokers, and cleaners. Although designed more particularly for incandescent lighting stations, both continuous and alternating, many of the rules are equally applicable to arc station work. The rules evidently represent the result of considerable experience in the management of station employees and with slight modifications could be applied with benefit to many stations in this country. The instructions for each department are printed as a separate folder on linen backed paper so that they can be carried about constantly in the pocket.

Un Metodo per la Trattazione dei Vettori Rotanti od Alternativi ed una Applicazione di esso ai Motori Elettrici a Correnti Alternate. (A Method for the Treatment of Rotating or Alternating Vectors and an Application of the same to Alternate Current Motors.) Memoir by Prof. Galileo Ferraris. Reprinted from the Proceedings of the Royal Academy of Sciences of Turin. Turin, 1893. Vincenzo Bona. 24 pp. quarto.

REPORTS OF COMPANIES.

EMBARRASSMENT OF THE WADDELL-ENTZ COMPANY.

ON Feb. 14 Mr. Montgomery Waddell was appointed temporary receiver of the Waddell-Entz Company of Bridgeport, Conn., by Judge George W. Wheeler of the Superior Court. There has been given by the Waddell-Entz Company to R. Knauth, trustee, of New York, a chattel mortgage for $150,000 on the machinery, stock and movables in Bridgeport and New York. Mr. Knauth, as trustee, represents the following: Knauth, Nachod & Kuehne, Charles L. Colby, and Edwin Brown, subscribers for $10,000 worth of stock; C. E. Knoblouch, Thomas L. James, John Stratton, Henry F. Spencer, John C. Brown, Eugene Colby, Rowland G. Hazard, and Charles L. Brace, subscribers for from $2,500 to $5,000 of stock.

The inventory includes all the rolling stock, motors, and other property in the station of the company at One Hundred and Twenty-seventh street and Second avenue, New York City. The company is organized under the laws of the State of New Jersey. Its capital is $5,000,000. Mr. Waddell says that the inability to collect outstanding obligations due the company is the chief cause of the appointment of a receiver. The company hope to get straightened out very shortly.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE 84th meeting of the Institute will be held at Headquarters, 12 West Thirty-first street, New York City, on Wednesday, February 21, at 8 o'clock p. m.

The report of the Committee on Revision of the Rule Governing Elections, will be taken up for consideration. The rule as it would appear if amended as proposed by the committee, is printed on page lii of the January issue of the *Transactions*, and also in the February issue.

The following paper will be presented by Mr. H. Ward Leonard, of New York City: "How Shall We Operate an Electric Railway Extending 100 Miles from the Power Station." A proposed arrangement of apparatus for this purpose will be shown in operation at the meeting.

Also the following paper by Philip Mauro, Esq., of Washington, D. C.: "Concerning a Change of Policy in the Administration of the Patent Office."

MR. CHARLES RETTIE, E. E., 18 Geraint street, Liverpool, sends us a very striking calendar in colors that he has issued. It has several vignettes illustrative of electrical work, including one that shows the electrical ocean-going vessel of the future.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED FEBRUARY 6, 1894

Accumulators:—

Secondary Battery, H. H. Carpenter, St. Louis, Mo., 514,260. Filed Dec. 21, 1892

Has for its object to increase the area of active material without increasing the weight, bulk or cost of the cell.

Electrode for Secondary Batteries, J. Legay and L. Legay, Fils, of Levallois, France, 514.267. Filed Oct. 13, 1890.

Claim 1 follows:

An electrode for batteries composed of spirally twisted wires twisted together in the form of a cable.

Alarms and Signals:—

Circuit Controller, E. J. McEvoy, New York, 514,019. Filed Aug. 31, 1893.

A circuit controller actuated by the opening of a door or window.

Device for Preventing Railway Collisions, G. F. Klaffsy and F. Faltinowsky, New York, 514,083. Filed Nov. 3, 1893

An electric block signal system for steam railways which shall automatically check the movement of the train upon entering an occupied block.

Signaling System, J. G. Noyes and L. Winterhalder, Milford, Conn., 514,128. Filed July 3, 1893.

A signal system in which the "want" and the locality are sent over separate circuits and received and recorded at a central station.

Electric Alarm, F. Sauer and C. Hentzschel, Berlin, Germany, 514,202. Filed July 8, 1893.

An electric alarm for doors in which the circuit is completed upon the withdrawing of the lock or bolt.

Electric Signaling Device, J. N. Connolly, New York, 514,212. Filed Nov. 9, 1893.

Relates to means for mounting the bell and making connections with the circuit.

Auxiliary Fire-Alarm Telegraph, J. Sachs, New York, 514,279. Filed Apl. 20, 1893.

Relates to fire alarms in which a signal is sent upon a main circuit leading to a central office by means of auxiliary circuits leading to a number of local auxiliary boxes, so that by the operation of one of the latter an alarm is transmitted on the main circuit in the same manner as if it had been directly transmitted from the main alarm mechanism.

Signaling Apparatus, E. R. Wilder, New York, 514,297. Filed May 1, 1893.

Claim 1 follows:

A signal tape having the signals embossed therein in combination with a circuit closer moved by contact with the embossed surface and a bolster to hold up the embossed portion while acting on the circuit closer.

Automatic Electric Fire Alarm, W. A. Guthrie, Durham, N. C., 514,361. Filed Aug. 19, 1893.

A thermostatic fire alarm in which the circuit is completed by the fusing of an alloy.

Fire Alarm and Sprinkler, W. A. Guthrie, Durham, N. C., 514,362. Filed Oct. 17, 1893.

Electric Signaling Apparatus for Railways, E. C. Wiley, Bristol, Tenn., 514,398. Filed May 11, 1893.

An automatic electric block signal system.

Conductors, Conduits and Insulators:—

Electric Conductor, H. F. Chick, Watertown, Mass., 513,982. Filed May 1, 1893.

Employs a braided covering outside of which is a braided wire protecting jacket.

Electrical Conductor, N. Tesla, New York, 514,167. Filed Jan. 2, 1892.

Has for its object to prevent interference by induction on line conductors carrying high potential alternating currents, and provides between the sheath of the conductor and the ground a path of very high ohmic resistance. (See THE ELECTRICAL ENGINEER, Feb. 14.)

Insulator, L. B. Gray, Boston, Mass., 514,221. Filed June 22, 1893.

Employs a supplementary insulator surrounding the peg and held against the cross bar by screwing the insulator proper down upon it.

Distribution:—

Load-Governor for Electric Currents, F. E. Pritchard, Oswego, N. Y. 514,030. Filed Nov. 19, 1891.

Employs a resistance coil connected to one conductor and a movable contact arm connected to the other, and a governor for forcing the movable arm into contact with the resistance.

Electrical Transmission of Power, R. M. Hunter, Philadelphia, Pa., 514,228. Filed Nov. 18, 1889.

Relates to the generating of currents of high potential for long distance transmission and transforming them to currents of lower potential at the points where they are required for service.

Dynamos and Motors:—

Dynamo and Motor, M. Waddell, Bridgeport, Conn., 514,047. Filed March 13, 1893.

Relates especially to the form of the brush carrier and its support.

Electric Motor, J. D. Ihlder, Yonkers, N. Y., 514,077. Filed Sept. 29, 1893.

An elevator motor having a shunt field magnet coil connected to the terminals of the supply circuit, a series field magnet coil included in the armature circuit and a resistance arranged in parallel with the series field magnet circuits.

Electric Elevator Motor, J. D. Ihlder, Yonkers, N. Y., 514,078. Filed Sept. 29, 1893.

Similar to No. 514,077.

Alternating Dynamo, J. J. Wood, Fort Wayne, Ind., 514.140. Filed June 20, 1893.

The invention relates to the mounting of the resistance in the field regulating shunt, in the construction of the commutator and brush yoke, and in means for retaining the exciting coil in place on the poles of the field magnet.

Commutator Brush, J. F. Kester, Buffalo, N. Y., 514,150. Filed Nov. 23, 1893.

A lubricator leaf for commutator brushes provided with interstices filled with a lubricating materal composed principally of beeswax.

Means for Generating Electric Currents, N. Tesla, New York, 514,168. Filed Aug. 2, 1893.

Provides means for compelling the discharge to take place through an insulating liquid and between terminal points brought together and separated periodically by the flow of the insulating liquid. (See THE ELECTRICAL ENGINEER Feb. 14.)

Magneto Electric Machine, A. J. Potter, New Hartford, N. Y., 514,241. Filed June 15, 1893.

Regulator for Electric Motors, S. H. Short, Cleveland, O., 514,429. Filed Jan. 26, 1891.

Employs two independent commutating switches for connecting the coils of different field magnets in multiple or in series, a rheostat included in the field circuits of both motors, a reversing switch in the field circuit of each motor and means for connecting the commutating switches and rheostat so that the parts may be operated simultaneously from either end of the car.

Galvanic and Thermo-Electric Batteries :—

Electric Battery, F. Bayer, New York, 514,115. Filed Aug. 24, 1893.

Employs an insulated supporting rod, an insulated cup containing mercury on the lower end of the rod and two sets of blocks of zinc strung upon the rod.

Lamps and Appurtenances :—

Hood for Electric Arc Lamps, S. Bergmann, New York, 514,057. Filed Jan. 10, 1893.

Electric Arc-Light Fixture, S. Bergmann, New York, 514,058. Filed Jan. 10, 1893.

Employs a removable holder for the lower carbon provided with an ash pan.

Electric Arc Lamp, G. G. Wagner, New York, 514,139. Filed November 15, 1892.

Employs electrodes in the shape of sectors fed horizontally towards each other by electromagnetic controlling apparatus.

Incandescent Electric Light, N. Tesla, New York, 514,170. Filed Jan. 2, 1893.

Claim 1 follows:

In an incandescent electric lamp, the combination of an exhausted globe, a refractory light-giving body therein, a conductor leading into the globe and connected to or supporting the said body, and a conducting screen surrounding the said conductor.

Electric Arc Lamp, R. M. Hunter, Philadelphia, Pa., 514,229. Filed May 9, 1893.

Employs carbons placed at an angle to each other, means for moving them toward one another and a device to rotate one of the carbons upon its axis.

Electrolier, E. E. Clift, Philadelphia, Pa., 514,305. Filed July 1, 1891.

Globe Holder for Arc Lamps, J. T. Dempster, Summit, N. J., 514,417. Filed Feb. 13, 1893.

Electric Arc Lamp, W. B. Luce, Brookline, Mass., 514,425. Filed March 16, 1893.

Has for its object to support the upper carbon so that it will be moved to establish the arc by means of an electromagnet in the main line circuit, dispensing with a low resistance solenoid.

Measurement :—

Inductive Mechanism for Electrostatic Instruments, W. E. Aryton and T. Mather, London, Eng., 513,975. Filed May 1, 1893.

Employs a skeleton needle of light periphery and curved fixed sheet inductors embracing both faces of the needle peripheries.

Electrical Measuring or Indicating Instrument, S. E. Hitt, Rockford, Ill., 514,075 Filed April 7, 1893.

Claim 1 follows:

An electrical measuring or indicating instrument arranged in connection with a spherical magnetic shield entirely surrounding the same and adapted to protect the instrument from exterior magnetic influences.

Electric Meter, C. Rabb, Kaiserslautern, Germany, 514,131. Filed Jan. 21, 1893.

Claim 1 follows:

In electric motor meters, the combination of a revolvable armature lying in a shunt and consisting of solenoids, solenoids comprising the magnetic field and a damping disc.

Temperature-Compensating Device, W. H. Bristol, Hoboken, N. J., 514,258. Filed Oct. 31, 1893.

Consists of a resistance and a thermometric device automatically maintaining the resistance constant under variations in temperature.

Instrument for Measuring and Regulating Electrical Resistances, G. B. Lawrason, New Orleans, La., 514,325. Filed Juue 31. 1893.

Acts upon the principle of the Wheatstone bridge with a modification whereby increased range and accuracy of measurement may be obtained.

Metallurgical :—

Method of and Apparatus for the Electrodeposition and Refining of Copper or Other Metals, L. S. Randolph, Baltimore, Md., 514,275. Filed Aug. 24, 1893.

Process of Electrolytic Separation of Nickel from Copper, P. De P. Ricketts, New York, 514,276. Filed Apl. 20, 1892.

Miscellaneous :—

Organ, R. Hope-Jones, Birkenhead, Eng., 514,146. Filed Aug. 8, 1892.

Insulated Pipe Coupling, E. E. Clift, Philadelphia, Pa., 514,304. Filed Oct. 10, 1892.

Electrode for Use in the Manufacture of Chlorine and Caustic Soda, J. Greenwood, London, Eng., 514,318. Filed Jan. 10, 1893.

Railways and Appliances :—

Conduit Electric Railway, R. C. Beardsley, Lafayette, Ind., 514,056. Filed Jan. 23, 1893.

Claim 1 follows :—

The combination of the slotted conduit and the switch boxes arranged alongside the same, electric switches in the boxes, movable parts of which project into the conduit, and removable covers for the boxes upon which a portion of the switches is mounted.

Electric Car Truck, C. F. Winkler, Kingston, N. Y., 511,109. Filed May 22, 1883.

Relates especially to means for mounting the motor flexibly upon the truck.

Closed Conduit Electric Railway, F. M. Ashley, Hawthorne, N. J., 514,112. Filed Dec. 23, 1892.

Claim 7 follows :

In an electric railway, a sealed conduit, a switching device moving in said conduit, means for maintaining a pressure of air in the conduit and an air lock at the end of the conduit through which the switching apparatus may pass.

Electric Railway, F. M. Ashley, Hawthorne, N. J., 514,113. Filed Dec. 23, 1892.

Employs a hanger at the joints of the insulated section of trolley wire consisting of two metallic plates bolted to the opposite sides of a block of insulating material and respectively connected to the ends of the sections.

Electric Railway Conduit, F. M. Ashley, Hawthorne, N. J., 514,114. Filed Dec. 23, 1892.

Employs a normally insulated conductor which is brought into contact with the feed wire by the attraction of a magnet on the car.

Electric Railway, O. A. Enholm, New York, 514,120. Filed Oct. 3, 1892.

Employs a conduit divided into two longitudinal compartments, one sealed and the other open, a circuit controller running in the sealed compartment, a collector running in the open compartment and electromagnetic apparatus carried with the collector and controlling the movement of the circuit controller.

Underground Electric Conductor, H. A. Seymour, Washington, D. C., 514,133. Filed Aug. 30, 1890.

Claim 1 follows :

The combination with a tube flexible on its under side, of an electrical conductor located within the tube, and supported therein out of contact with the inner walls of the tube, and electrical contacts secured to the under side of the tube and adapted to be lifted into contact with the electrical conductor by an under-running trolley.

Closed Conduit for Electric Railways, H. A. Seymour, Washington, D. C., 514,131. Filed Aug. 29, 1892:

Similar to No. 584,133.

Motor Controlling Device for Electric Locomotive, S. H. Short, Cleveland, O., 514,135. Filed Jan. 9, 1890.

The invention consists in two operating shafts connected with switches for reversing the motor and varying its speed.

Electric Trolley Wheel Shield, H. S. Pruyn, Hoosick Falls, N. Y., 514,274. Filed May 10, 1893.

Series Electric Railway, M. A. Cattori, Rome, Italy, 514,303. Filed May 18, 1893.

Employs a conductor consisting of the insulated sections and movable conducting circuit breakers in the gap between each two sections adapted to be operated by the locomotive to open or close the gap.

Trolley Wire Shield, L. Eschner, Philadelphia, Pa., 514,358. Filed April 30, 1892.

A continuous shield covering the trolley wire and protecting it from contact with other wires.

Switches and Cut-Outs :—

Cut-Out Block, E. J. McEvoy, New York, N. Y., 514,018. Filed July 29, 1893.

Rheostat, J. T. Birch, Pittsburgh, Pa., 514,301. Filed Nov. 16, 1893.

Employs two rotatable wire helices, the members of which are insulated from one another, and a contact plate movable along the helices.

HOW IT STRIKES THE LOVER OF DUMB ANIMALS.

In a recent issue *Our Animal Friends* has the following appreciative note :

> In its Electrical Transportation Department, THE ELECTRICAL ENGINEER for December 13th has two articles of particular interest to any one who cares for animals. "Electricity on the Erie Canal," by F. W. Hawley, shows that "the experiments recently made at Rochester are entirely satisfactory, and fully demonstrate the possibility and practicability of applying electricity in navigating the Erie. Canal boats, as they exist to-day, are of the type most suitable for economy. A man may be his own motor-man with the trolley system. In horse boats, the quarters of the animals and forage storage can be so reduced as to add considerably to the storage capacity." The other article is entitled "An Electric Traction System of Hauling Boats on the Erie and Other Canals." It is by Joseph Sachs, who has recently devised a system of hauling canal boats, which he and others consider a most feasible system of electrically operating canal boats. "The primitive method of operation by *pulling from the shore* is adhered to; but for the faithful, but slow and uneconomical, animal is substituted an equally sure and faithful, but more rapid and economical, electro-mechanical mule." The old-fashioned mule, we think, will be glad to have Mr. Sachs' plans adopted.

ELECTRICAL WORK IN MONTREAL.

The Royal Electric Co., of Montreal, Canada, through their general agent, Mr. D. A. Starr, have closed an important contract with the Montmorency Electric Power Co., of Quebec, for a large alternating plant to replace the old one. The station of the latter company is located at Montmorency Falls, six miles from the City of Quebec. The entire water power of the falls which is one of the grandest in the world, is owned by the company. The available head is 160 feet. A new power house has just been erected under the superintendence of the best hydraulic engineers and is to be equipped with new machinery. The water wheels are set horizontally and run at 600 revolutions per minute. Eight wheels have been installed, four of 620 h. p. each, and four of 310 h. p. each. The smaller wheels are to operate the arc plant which is of the Thomson-Houston system and manufactured by the Royal Electric Co. The larger wheels are for the alternating dynamos which have been specially designed by Mr. R. A. Ross, chief electrician of the Royal Electric Co., to comply with specifications prepared by the electrician of the Montmorency Electric Co. These alternators, which have revolving fields and stationary armatures, are the first of the type to be made in Canada and possess a number of novel features. The contract is for four 210 K. W. dynamos to run at 600 revolutions per minute. The current to have a frequency of 60 periods per second and a pressure of 2,500 volts at full load. The armatures contain no iron and the coils, which are machine wound of strip copper, are interchangeable so as to be easily replaced. Two dynamos are to be mounted upon one base and coupled together by a clutch so that they can be arranged to run in parallel or to give two-phase currents for power. Each pair is to be belted to one of the 620 h. p. water wheels. The switchboard is to be of marble and divided into panels to permit of adding extra dynamos by increasing the number of panels correspondingly. A full description of the plant will be given as soon as it is in operation. In addition to this large contract, the Royal Electric Co. have secured the order for all the transformers for the city lighting.

The officers and staff of the Montmorency Electric Power Co. are as follows: Andrew Thomson, president; F. H. Badger, Jr., general manager, and Lewis Burran, electrician.

MR. E. P. ROBERTS, of Cleveland, who prepared the specifications for the electric light plant of the Home Savings Bank Co., of Detroit, writes us that the two engines will be "Ideal"; the dynamos, switchboard and wiring will be furnished by the Detroit Motor Co., and the wiring will be Okonite in Interior Conduit. The Specifications were very complete giving the feet of wire on each floor and the total of each size, etc. There will be over two miles of No. 14 wire with less quantities of larger sizes.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

WORLD'S FAIR TEST OF WEBSTER SEPARATORS.

Messrs. Warren Webster & Co., of Camden, N. J., have issued a neat little facsimile copy of the test of their steam and oil separators made by Mr. George H. Barrus in the power house at the World's Fair. From the figures obtained it appears that the steam separator intercepted 17½ per cent. of moisture, which was, within the limit of errors, all that the steam contained. In the oil separator test one pint of cylinder oil, weighing 15 ounces was discharged into the cylinder, 86.7 per cent. of which was withdrawn from the separator, the remainder disappearing in the process of lubricating the cylinders and working parts, etc.

The pamphlet gives the full text relating to the test and is very interesting and concise. Other comparative tests were made, as the result of which Warren Webster & Co. were awarded three medals and diplomas; one for the Webster vacuum feed water heater, one for the Webster separators and one for the Williams vacuum system of steam heating.

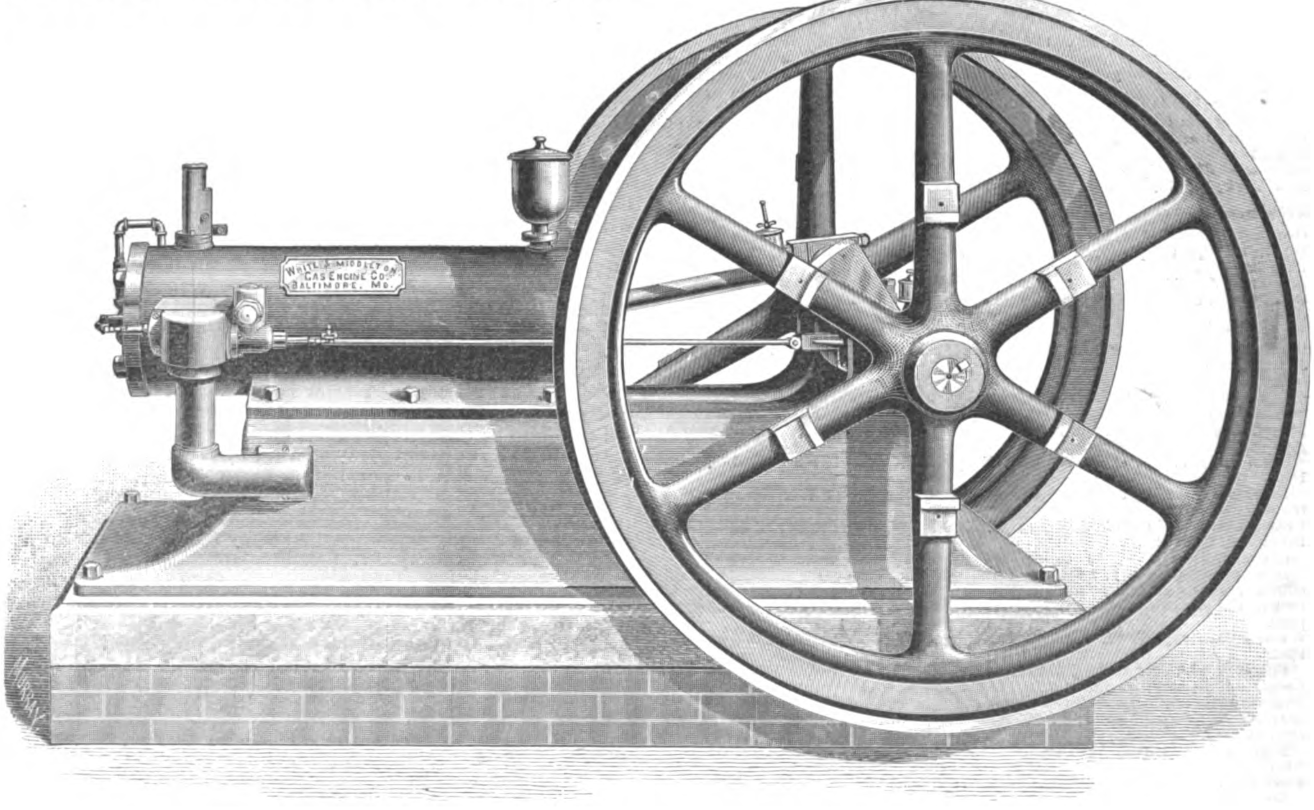
THE WHITE & MIDDLETON GAS ENGINE.

The accompanying illustration shows the general design of a gas engine built by the White & Middleton Gas Engine Co., of East Falls avenue and Pratt street, Baltimore. This engine is built in sizes ranging from 15 to 60 h. p. It has no valves and the igniter is a very simple and durable device, with no springs or mechanism of any kind to control it. The governor also is simple and substantial, attached directly to the crank-shaft, and insures regular speed under varying loads, controlling the quantity of gas for amount of work done.

The engine is furnished with automatic oilers on all working parts, and requires about the same grade of lubricating oils as an ordinary steam engine. The crank-shafts, connecting rods and other working parts are made out of the very best open-hearth forged steel and have heavy bronze metal bearings, and the workmanship is excellent. The iron castings are made from the best charcoal iron and every engine is thoroughly tested before leaving the shops. All parts are made interchangeable, so that duplicate parts can be furnished at a moment's notice in case of accident.

The company also make gas engines, in sizes from 3½ to 12 h p., in a slightly modified form. All are guaranteed not to consume more than 15 cubic feet of gas per h. p. per hour; the gas being of the quality of that used in Baltimore.

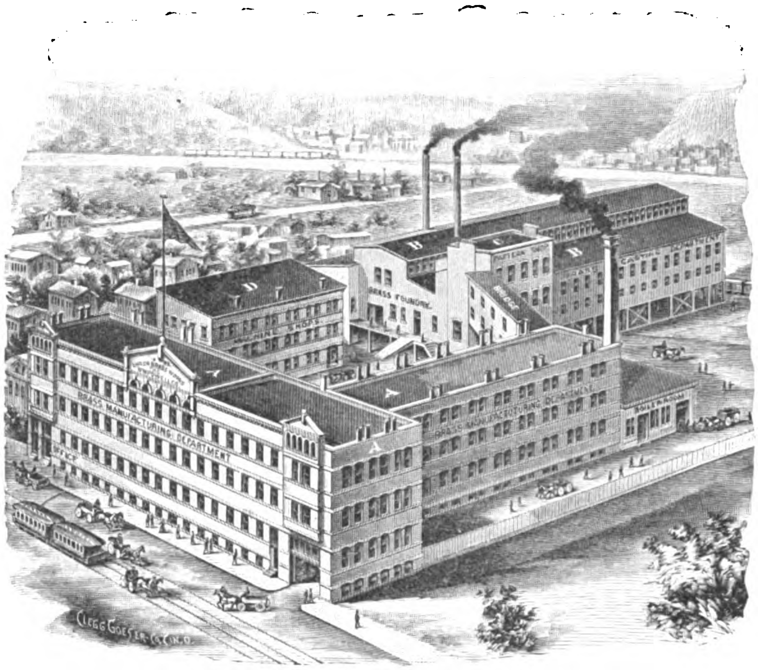
The New York agents of the company are Kimberger & Clements, 158 West Broadway.


WHITE & MIDDLETON GAS ENGINE CO. BALTIMORE, MD.

THE WHITE & MIDDLETON GAS ENGINE.

THE NEW PLANT OF THE WM. POWELL CO., OF CINCINNATI, OPERATED BY ELECTRIC MOTORS.

The Wm. Powell Co., of Cincinnati, Ohio, have recently erected what is said to be the most complete plant of its kind in the country. The company manufacture brass work of kinds necessary for the thorough equipment of mills, furnaces, refineries, foundries, gas and electric light plants, etc., and their business necessitates the extensive factories and warehouses that they have built at Nos. 225 to 231 Spring Grove avenue, which are shown in the accompanying illustration.



THE WM. POWELL CO.'S FACTORIES, CINCINNATI, O.

Of the various buildings, A contains the offices, warehouse and brass finishing department, and is 119 feet wide and 3 stories high, by 175 feet long, built of pressed brick trimmed with sand stone, giving a very handsome and substantial appearance. Building B is the foundry 60 by 150 feet, and C the pattern house. Each building is separate and distinct, being isolated as much as possible for protection against fire. The engine is of 150 horse power, Corliss type, and the boiler an upright one of their own design. They have an 85 horse power generator which furnishes the current for five motors distributed throughout the various buildings and also for lighting 350 incandescent lights and 10 arc lamps.

The specialties of the company are Star valves, Star sight feed lubricators, signal and stop feed oilers, grease cups, guard steam stops, etc., and are standards of excellence and durability. They are kept in stock by supply houses throughout the country.

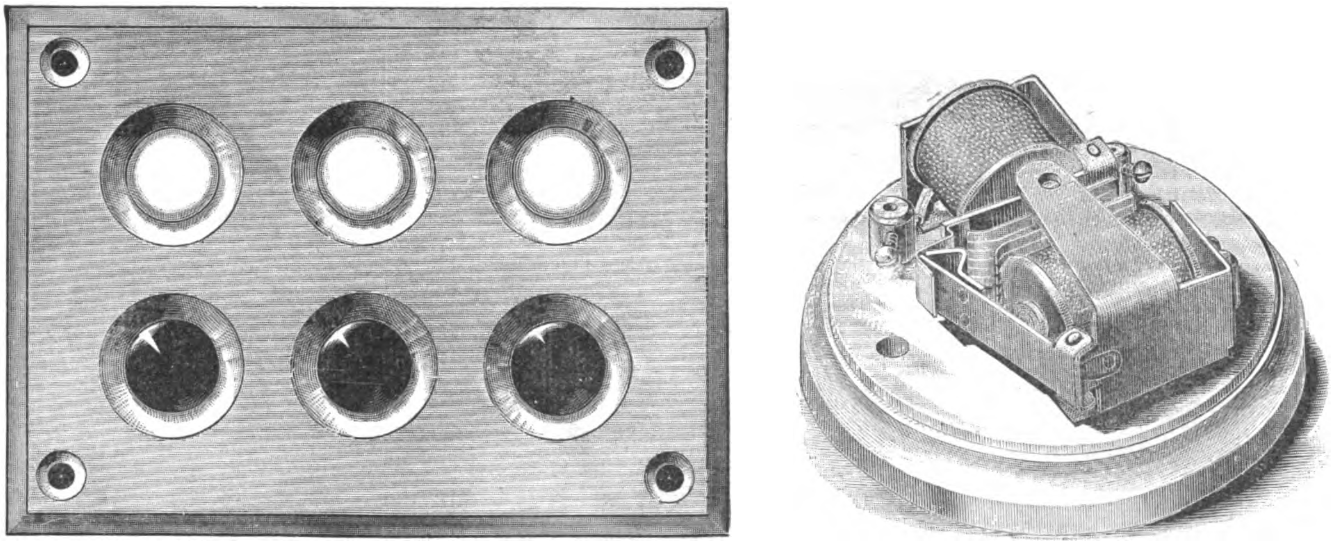
THE IMPROVED SECHRIST AUTOMATIC SWITCH.

The Central Electric Company of Chicago are introducing to the Eastern and Central trade the new Sechrist automatic switch for controlling electric lights. The system is especially adapted for controlling incandescent lights in private residences and in that capacity alone gives a great range of possibilities for convenience and comfort, besides being adapted for a number of other uses among which are the controlling of electric lights and bells for railway signaling, etc.

Fig. 1 shows a six button plate controlling three automatic switches. The metal plate, finished to match the hardware with white and black pearl buttons, is ornamental, which is one of the most important features in residence work. Instead of being collected on a metal plate the buttons may be of pearl or ivory set in the casings of the doors. The switch shown in Fig. 2 is located in some out of the way place where it cannot be seen as it requires no attention whatever.

By means of this device a person may have absolute control of any or all of the lights from any part of the house, and a button outside, which turns on the porch light, enables one to readily unlock the front door.

Immediately on opening the door the hall, parlor, library or dining room lights may be turned on or off. The hall lights may be operated from either the first or second stories, and also from each chamber. Conveniently located beside the bed may be another set of buttons controlling all the lights in the house. A convenient and novel scheme was introduced recently in a Denver residence. The wires from an automatic switch controlling the cellar lights were attached to the cellar steps so that a person going down cellar and returning, automatically turns the cellar lights on and off. The owner found that it made quite a difference in the electric light bills at the end of the month, as he had been considerably annoyed before, by the absent-mindedness of the servant in forgetting to turn off the cellar lights when they were not needed. The small bell wires which run to the various push buttons may be readily attached to the doors and windows of the house; the mere act of opening them will turn on or off the lights, or the wires may be attached to an electric mat concealed under a rug or carpet. The latter is applicable more especially as a burglar alarm.



FIGS. 1 AND 2.—THE IMPROVED SECHRIST AUTOMATIC SWITCH.

The switch itself shown in Fig. 3, is very simple in construction, being simply a locking and releasing device operated by means of two electromagnets. There are no adjusting screws or complicated parts. The circuit is attached to the switch the same as to any common switch, while the wires from the magnet spools, which are common bell wires, run to the different push buttons from where the switch is to be controlled. The switch may be operated with either an ordinary battery or by means of the electric light current. In using the latter Mr. Sechrist prefers to reduce the current, through a resistance box to the strength of an ordinary battery. The method of running the wires and connecting them to the switch may be readily understood by referring to Fig. 3. Here A A represents the back of the switch; B, a group of lights to be controlled; S, an ordinary switch loop connected to the switch; *a* and *b*, are wires supplying the reduced current; *b*, *c* and *d* are ordinary bell wires which run to the different push-buttons; C and D are two sets of buttons controlling the switch A A. Any number of push-buttons may be connected to the wires *b*, *c* and *d*, and one resistance box may be used to supply current for any number of switches.

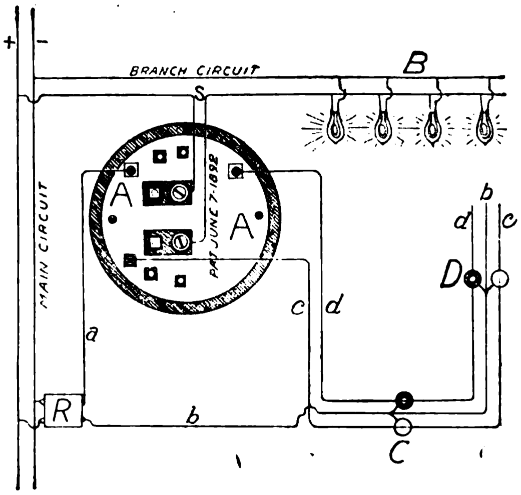
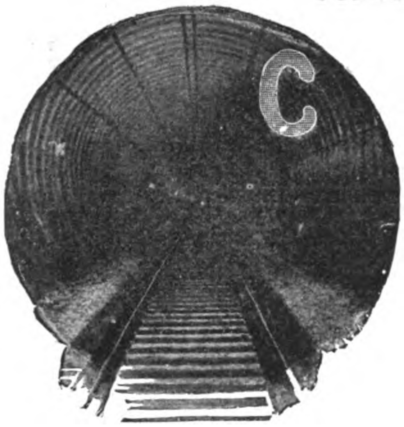


FIG. 3.—SECHRIST AUTOMATIC SWITCH.—DIAGRAM OF CIRCUITS.

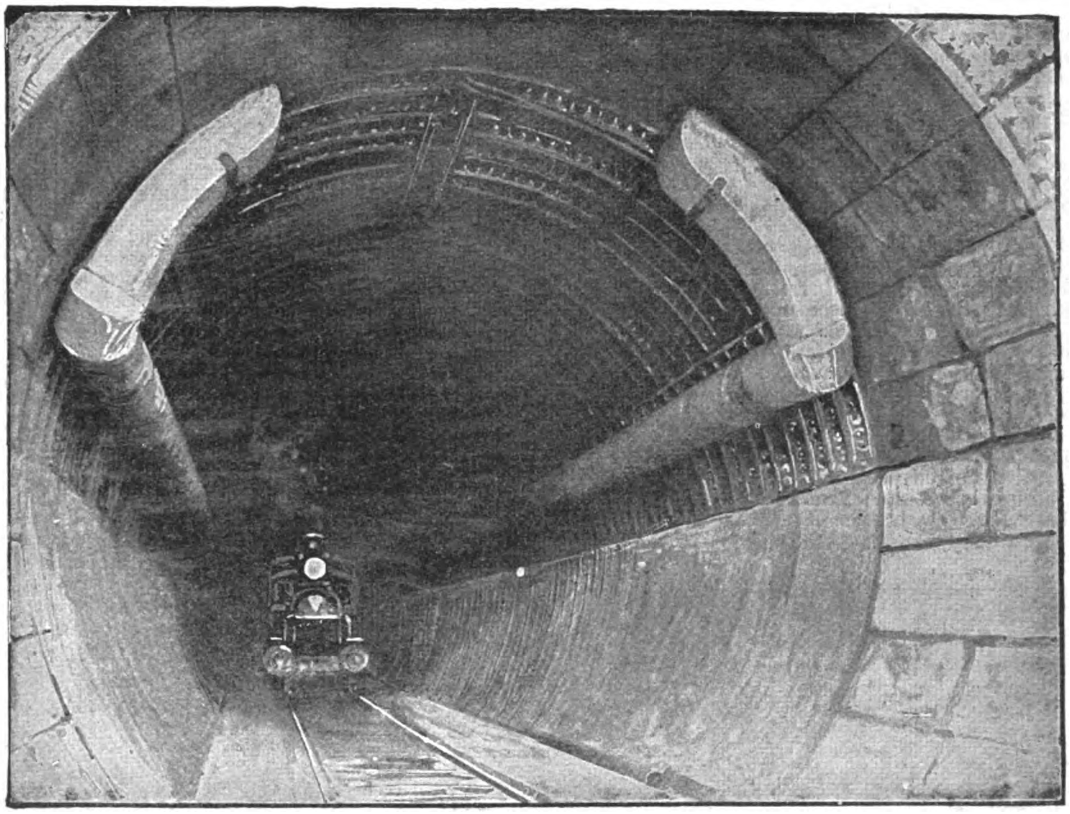
The Sechrist automatic switch system is certainly a success so far as residence lighting is concerned, and is very popular wherever it has been introduced. We have frequently described and illustrated its earlier forms, and are glad to record the perfection of so interesting and practical a device.

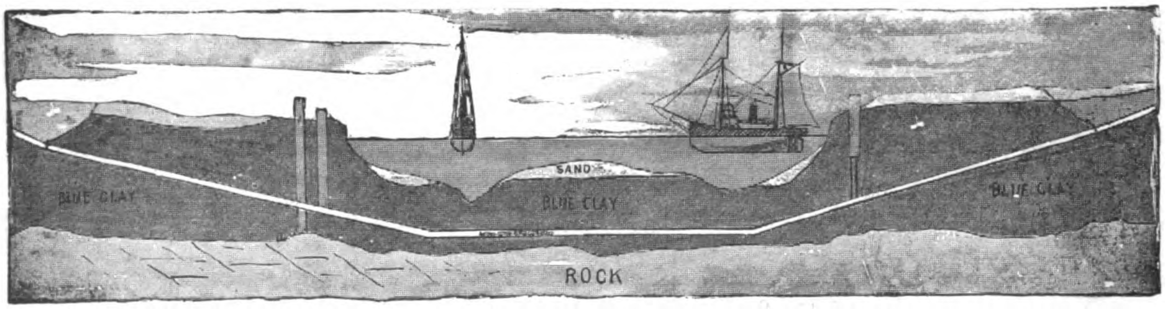
THE CONSOLIDATED ECONOMIZER COMPANY of Boston, whose headquarters are at No. 8 Oliver street, are making a specialty of installing power plants with their system of forced draft, eliminating all necessity for the usual smoke stack. This company own the valuable patents on the Lowcock, Hawkins and Hirt economizers, and guarantee a large saving in fuel and expense both in construction and operation. Economizers are becoming more popular every year in this country, and numbers of them are now in operation in electric plants, utilizing the waste gases for heating the feed water. We would call our readers' attention to their advertisement on another page, which illustrates the Consolidated Economizer Co.'s method of construction.

KERITE CABLES IN THE GREAT ST. CLAIR TUNNEL.



CANADA and this country may alike congratulate themselves upon the enjoyment of one of the largest and most successful of recent engineering feats in the magnificent St. Clair tunnel between Sarnia, Ont. and Port Huron, Mich., by means of which the water passage, across the Straits of St. Clair, at the foot of Lake Huron, is avoided, and a continuous journey by rail between the United States and the Dominion can be made, just as it is many hundred miles eastward over the Bridges at Niagara Falls and Montreal. It may be stated that the tunnel is now in full operation and is largely used by the Grand Trunk Railway for both passenger and freight service. This has some bearing on the underground rapid transit question in New York City from the fact that the tunnel, as also proposed here, is nothing more nor less than an iron tube. The diameter is 19 feet 10 inches, and the length 6,025 feet. To this is additional 5,063 feet of portal and approaches, making about a little more than two miles. Our illustration of the sectional full length view gives a good idea of the civil engineering involved in cutting the bore for the tunnel. No fewer than 4,000 cars can be daily moved through the tunnel, and no less a sum than $2,700,000 was spent in providing this great facility for travel and commerce.





The Great St. Clair Tunnel at the Foot of Lake Huron.

It is interesting to note that American manufacturers undertook a large share of the work, and that they have the satisfaction of finding their products most highly approved by the Canadian authorities. The lighting of the tunnel was done by the Edison Co. on the American side supplemented by the Ball Electric Light Co. of Canada. Packing for the cast iron segments of the tunnel, was of the "P. & B." make, furnished by the Standard Paint Co. Root blowers were supplied for ventilation, and one of our cuts shows the runs of piping made and installed by the Abendroth & Root Mfg. Co., the well known tube and boiler house of New York City. But perhaps the part of the enterprise most interesting to electrical engineers was that carried out by Mr. W. R. Brixey, the manufacturer of Day's Kerite wire and cables. That part was the making of 6,000 feet of 18 conductor aerial cable by Mr. Brixey for use in the tunnel, for the Great North Western Telegraph Co. These cables can be seen in our perspective view of the tunnel. It is needless to say that the test is a most severe one, as the cables are incessantly subjected to the deteriorating influences of steam, smoke, soot, etc. The telegraph company has, however, recently reported to Mr. Brixey on this cable in high terms of praise.

Altogether the tunnel embodies some of the best engineering of the day, and include some of the finest manufactured products, as we have shown. It is to be hoped that at no distant date, the electrical part may be added to by replacing the present big steam locomotives, reputed the biggest in the world, by electric motors of some such type as that which Mr. Frank J. Sprague exhibited in the pages of The Electrical Engineer a few months ago.

THE NATIONAL TELEPHONE COMPANY'S NEW SYSTEM OF COMPLETE METALLIC CIRCUIT.—SWITCHBOARDS FOR EXCHANGES.

The accompanying sketch, Fig. 1, exhibits the exchange system of the National Telephone Company of Boston, for which a patent has been applied and which embraces novel features entirely their own. One of the leading patent lawyers in the country has assured them that they avoid all existing patents, and therefore they are prepared to protect their customers from any damages arising from alleged infringement. They claim for their system that it is most simple, free from all complications, while its economical features will commend and place it within reach of all.

The wires used with the system will doubtless be in many instances supported upon electric light or trolley wire poles already erected. It is imperatively necessary in such cases that this metallic circuit system be used, to prevent induction. One wire is carried from the switchboard to each subscriber. A general return wire and calling wire connected to binding posts on head receiver of operator, "gridirons" the territory to be operated by the exchange—one binding post of each subscriber's instrument taps the general return wire. The key in the drawing represents cord connection in the bell box. For example, station No. 1 desires to talk with station No. 3; No. 1 takes the receiver from its holder (as shown in Fig. 2), places it to his ear and pulls down the cord at bottom of bell box; this connects him with the "calling wire" running to head receiver of operator; he then calls into his transmitter 3 on 1; the operator makes the desired connection at the switchboard; when the cord is released a sharp click is heard which determines the fact that the call has been received and desired connection made. No. 1 will now be enabled to ring up No. 3 direct and upon taking receiver from its holder No. 1 talks direct with No. 3 the operator being cut-out and unable to hear the conversation. There is no "ground" connection of any kind, a complete metallic circuit being thus secured and a large saving in wire expenditure secured over all known metallic systems now in use. The wire will be completely free from all cross-talk as this is absorbed by the general return wire.

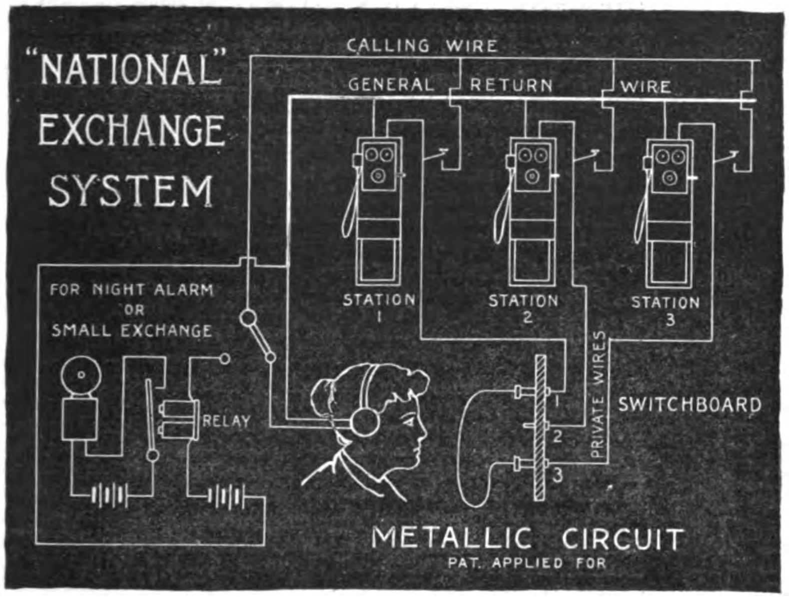
The annunciator system, also complicated switching devices, are avoided. There is nothing to prevent the use of a grounded circuit—the above system simply applying to wires supported on electric light or trolley wire poles when a metallic circuit is necessary to provide against induction.

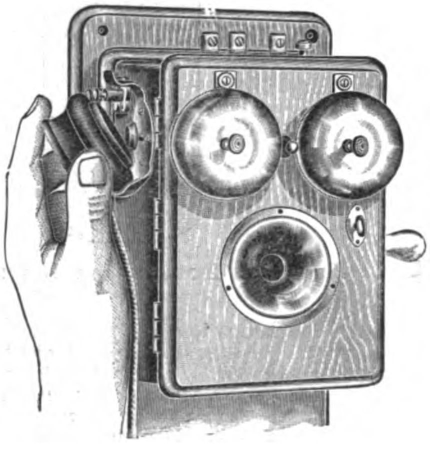
If, upon turning the crank of the bell, his own bell refuses to ring, it is evidence that telephone No. 3 is busy talking with some other subscriber, and No. 1 will have to call again later on, unless the operator should ring him up, having connected the line in the meantime. After conversation is completed, before replacing the receiver in its holder, No. 1 again pulls down the cord from bottom of bell box and calls into his transmitter, "disconnect No. 1;" this must always be done, for, should another subscriber desire to talk with No. 1, the operator would think his line still in use.

In small exchanges or central stations that may be located in a postoffice or store, or at any place where the continuous services of an operator are not warranted on the score of economy, a clerk or any other party may serve. The operator's instrument can be switched on to an alarm to sound a call when a subscriber desires to be connected, the subscriber pulling down his cord below the bell box and listening until his call is answered by "central," who will connect as requested.

The subscriber, when connected by "central," is enabled to do his own ringing up, as a call is not always promptly replied to. This feature alone permits the permanent operator to attend to answering calls, making connections without losing time in ringing bells and waiting for delinquents. This will also apply to a clerk or other party acting as operator; they will simply connect the wires, leaving the subscriber to do his own ringing up. The subscriber is also assured of the fact that if he cannot ring up the party wanted, it is by no means the fault of central office.

As above stated, metallic circuits must be used in connection with an exchange system if electric light or trolley wire poles are to be utilized or are near by. The wire used should be of No. 14 or 16 gauge hard drawn copper, which is the cheapest wire in the end. The National Telephone Company are prepared to furnish them with necessary porcelain insulators, etc., at market rates.





Figs. 1 and 2.—The National Telephone Company's New System of Complete Metallic Circuit.

THE METROPOLITAN ELECTRIC EQUIPMENT COMPANY.

This company has been recently organized to perform all kinds of electrical work appertaining to buildings including tubing, wiring, electrical appliances and fixtures, elevators, pumps, engines, dynamos, motors, shafting and ventilating apparatus, and to contract for the complete or partial equipment of buildings, using the system of the Edison Electric Illuminating Co. of New York.

Mr. Maurice T. Ward, the president, although a new comer in the electrical field, has had a business experience in this city of over twenty years. He is a member of the Produce, Maritime and Consolidated Stock Exchanges, and is well and favorably known in the commercial world.

Mr. D. Colombani, secretary and treasurer, has been for many years identified with the Edison Electric Illuminating Co. his specialty being the equipping of fashionable residences, churches, and theatres, in which, it is believed, he stands preëminent.

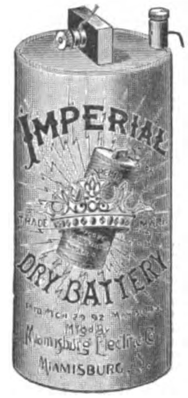
Mr. Jas. F. Hughes, the general agent, has also been connected with the Edison Electric Illuminating Co. a number of years, and has established the reputation of being most competent and successful in his particular field.

The company has been capitalized at $20,000, controlled entirely by the three officers mentioned.

The City of Minneapolis is advertising for proposals for a dynamo for the City Hall.

THE IMPERIAL DRY BATTERY.

While the "Imperial" has been on the market for more than three years, it has only been within the past year, since Mr. Wm. Burnley, its inventor, has connected himself with the Miamisburg Electric Co., that they have been manufactured in sufficient quantities to supply the demand. The result of his labors is the "Imperial," constructed on entirely new principles and a radical departure from all existing types of dry batteries. It seems easy enough to make a dry battery that will show very fair results for a short time, only; but, to hold its initial energy over long periods of time, and not have its E. M. F. deteriorate—as many have learned by experience—is not such an easy matter. But just in this particular the "Imperial," is strongest. The depolarizer used does not become a dead weight or resistance and it is not possible for the battery to deplete itself by used-up depolarizing matter, and, therefore, the possibility of internal short circuiting is eliminated. It consumes material only when the circuit is closed and will not, therefore, deteriorate when not doing work; thus giving back in actual service rendered an equivalent for money expended and possessing the superior merit of holding its initial power over long periods of time, enabling dealers to place them on their shelves without an appreciable deterioration. They are slow to polarize and quick to recuperate and not liable to rapid failure, and it is almost impossible to deplete the cell by exhaustive work.



The Imperial Dry Battery.

The cells are hermetically sealed and remain so, and will not boil over or burst the seal, and oozing of the salts from the top is entirely eliminated. Their internal resistance is small and they possess a high and quite constant E. M. F. The "Imperial" is not a closed circuit battery and should not be so used, but it is intended for all purposes for which an open circuit battery is used, and is constructed to meet all the conditions required for such a battery by the general trade. Its voltage is 1.5 and amperage from 7 to 10. Where higher amperage is wanted special batteries are made. The Miamisburg Electric Co., Miamisburg, O., are the sole manufacturers of the Imperial batteries.

NEW ENGLAND NOTES.

Prof. W. L. Puffer of the Mass. Inst. of Technology in a lecture on telephone receivers at the Wells Memorial Institute on Tuesday evening, stated that as a result of his experiments, the receiver telephone of the National Telephone Mfg. Co. of Boston, was the strongest and most powerful instrument he had found. Many receiver telephones both foreign and domestic were exhibited. The lecture was adjourned to Monday evening, Feb. 19th, when the subject of "transmitters" will be considered.

The Pettingell-Andrews Company of Boston have just made arrangements for a valuable addition to their staff in the person of Mr. Frank X. Cicott, who will hereafter have complete charge of their electric railway department. Mr. Cicott is a well known electrical engineer of wide reputation and was formerly a resident of San Francisco, as agent for Holmes, Booth and Haydens of New York. He did a large general railway supply business on the Pacific coast. He was then connected for some time with the Electric Merchandise Company of Chicago, and in 1891, started the first traction paper in the city of London, England, "The Railway World," acting as managing director of the paper for nearly two years. Mr. Cicott is still a director on the Board of Management of this paper, and is a large stockholder. Mr. Cicott's new connection will be pleasant to his many friends in the East, and with his valuable experience in railway work, and large acquaintance in the railway field, he will form a valuable acquisition to the Pettingell-Andrews Company.

THE "ACME" PORTABLE TESTING SET.

Queen & Co., Inc., Philadelphia, have just issued circular No. 520 regarding their "Acme" portable testing set. Besides containing prices and a general description of the outfit, it gives diagrammatic instructions which will prove very useful to parties handling the apparatus. The "Acme" set meets with great favor because of its compactness, completeness and simplicity.

WESTERN NOTES.

Wiley & Phelps, 1422 Monadnock Block, Chicago, will soon have one of the larger sizes of the DeLaval steam turbine dynamos in operation in that city.

Mr. Geo. McKinlock, president of the Central Electric Co., Chicago, who returned from the East recently, reports the outlook for business as very encouraging.

The Chas. E. Gregory Co., of Chicago, have just made up their first annual balance sheet, which shows sufficient net earnings to declare a substantial dividend to the stockholders.

The National Electric Co., through their agent, Mr. W. E. Bailey, have completed arrangements for an arc and incandescent electric plant for Wellsville, Mo., to be operated in connection with a roller mill.

Capt. Jno. Shay of the Chas. Munson Belting Co. Chicago, accompanied by Major H. V. Nourse, of the same company called upon their many Chicago friends last week, extolling the virtues of the "Eagle" and "Dynamo" brand of belting.

Mr. A. H. Goode, manager of the Western office of the Jenney Electric Motor Co., Monadnock Building, Chicago, reports the sale of two 650 light, and two 500 light dynamos and two 62 K. W. railway generators among last week's business.

Elkhart, Ind.—The electric light and street railway plant was sold at receiver's sale on the 7 inst. Mr. O. N. Lumbert, president of the old company bid it in for $21,000 and is said to be backed by out of town capital. The incumbrance was $75,000.

Taylor, Dee & Mack, Chicago, dealers in general electrical supplies have just added a very complete assortment of main line, double pole station switches to their stock. This firm is also the exclusive agent of the Solar Carbon Co. and Chicago agent for the well known "American" lamp.

The Lunkenheimer Company, of Cincinnati, have issued a neat little folder in which some of their newer valves are well illustrated. These have the well known "Lunken" renewable seat gate, and are claimed to be simpler, stronger, more compact and heavier in proportion than any other form of gate valve in use.

The Western Telephone Construction Co., Monadnock Building, Chicago, are moving into more commodious quarters on the fifth floor, where they will be better able to take care of their constantly increasing business. The recent trial of their magneto telephone transmitter between New York and Chicago is said to have been a great success.

Telephone Business.—As a direct result of the recent expiration of the Bell telephone patent may be mentioned the incorporation of a number of exchanges. Hardly a week passes but several telephone companies spring into existence. The Newark & Millington Telephone Co., Newark, Ills., and the Lincoln Mutual Telephone Co., at Lincoln, Ills., are among the recently incorporated companies.

Dr. F. H. Berry, D. D. S., of Milwaukee, Wis., has lately brought out an electric dental engine and other appliances, which contains many new and novel features both electrical and mechanical. He will be pleased to forward to any address on application a beautiful illustrated catalogue of his devices, and gladly answer any questions on what is needed electrically by members of his profession.

Messrs. P. H. Carey and **E. J. Shrader** have just been appointed selling agents for the Phœnix Iron Works, manufacturers of the well known Dick & Church engines. The Western agency will be located as heretofore at 519 The Rookery. Mr. Schrader is a mechanical engineer of wide experience, having been at one time assistant superintendent of the Union Iron Works, San Francisco, and more recently manager of the mining department in the Cincinnati office of the General Electric Co. Mr. Carey is a member of the firm of Harrison & Carey and his extensive acquaintance in the street railway and electrical field will no doubt be of considerable advantage to the new firm.

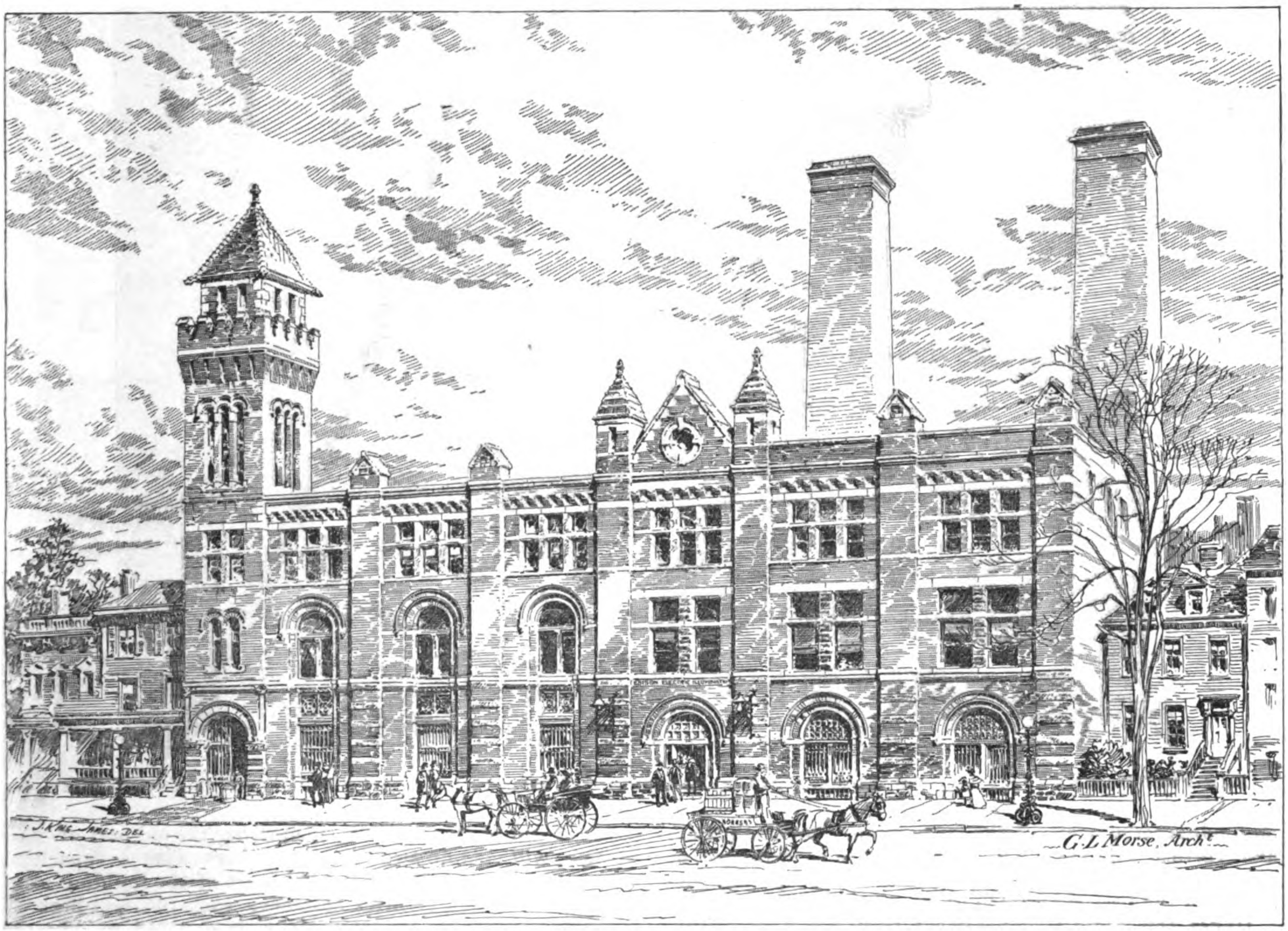
☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. FEBRUARY 28, 1894. No. 304.

THE NEW FIRST DISTRICT STATION OF THE EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.

THE Edison Electric Illuminating Company of Brooklyn began the designing of their First District Station on March 1, 1889, starting the operation of the plant September 1, of the same year. This station was laid out for 3,000 h. p. capacity, ample, it was then thought, to provide for at least five years' requirements. The fall of 1889, at the starting of the station, saw an equivalent of 6,000 16 c. p. lamps connected, and since then the progress has been as follows :



THE NEW FIRST DISTRICT STATION OF THE EDISON ELECTRIC ILLUMINATING COMPANY OF BROOKLYN.

1889	6,000
1890	25,172
1891	41,379
1892	75,450
1893	101,000

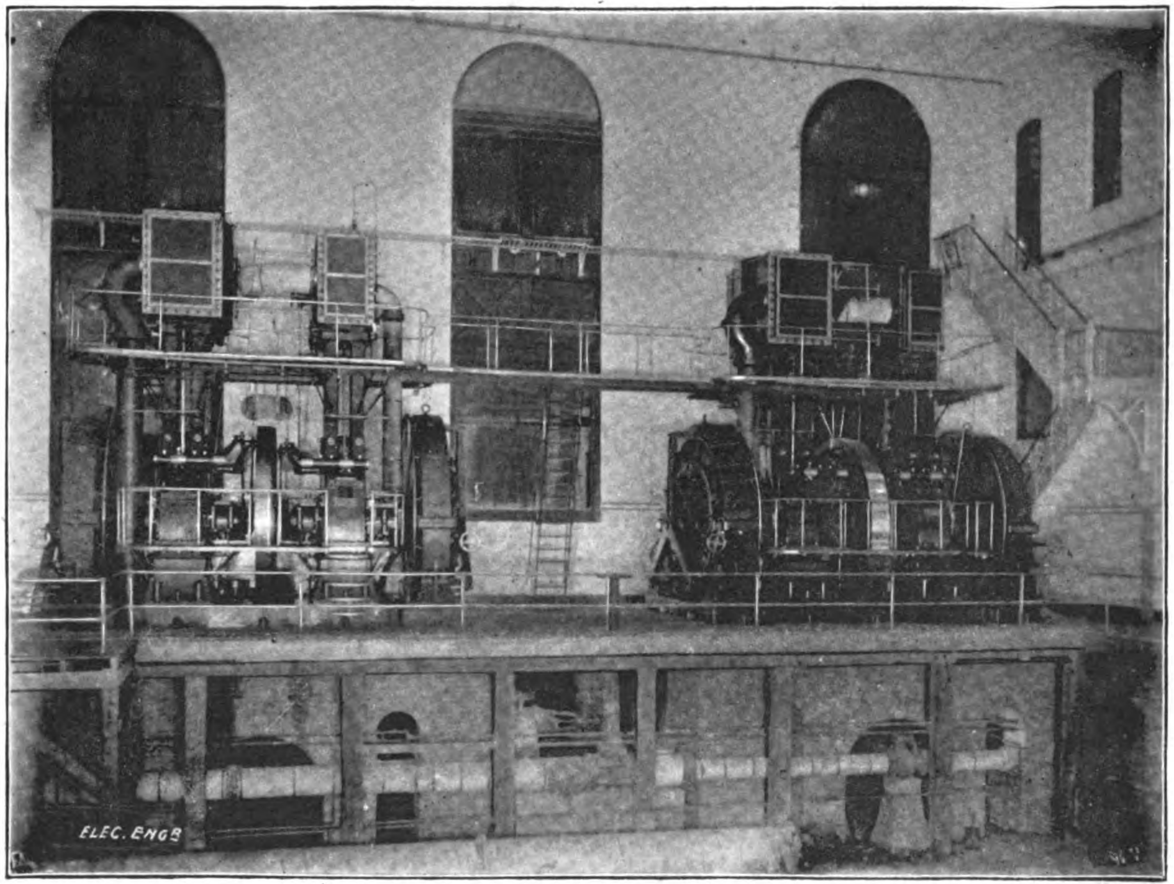
In order to keep up with this five years' increase, it was necessary to watch carefully central station construction, so that when a time came for quick action, it would not be necessary to indulge in temporary work, which is so exhausting to the funds of any company. During this time (of four years) three new stations have been built, and the original Pearl Street First District Station is now doubled in size and quadrupled in its capacity. Since the building of this station, so many improvements have arisen that we find central station construction work almost revolutionized, even down to the general character of the building, changed by the return to direct connected units, and the simplification of the distributing system as far as pressure regulation is concerned.

Plans for the new addition to the Pearl Street First District Station were commenced May 1, 1893, ground broken July 1, and the building occupied December 25. In preparing the plans care was taken to make the entire plant as now finished, consisting of old and new buildings, as complete as though it were one building, originally erected for its present capacity of 12,000 horse power.

The power room of the building in which are located all engines and dynamos, is 100 feet long, 65 feet wide, 35 feet high, and contains no columns, the ceiling being spanned by heavy girders. The room is lighted by three front and three rear windows, each thirty feet high and twelve feet wide, and as the entire interior is finished in white with wainscoating of glazed tile the natural lighting is as nearly perfect as possible, reducing to a minimum the cost of artificial illumination. At night 60 16 c. p. incandescent lamps furnish the general lighting, and each engine is individually illuminated by 20 16 c. p. lamps. The main object of having plenty of light was to detect easily any accumulation of dirt, oil, etc., the great enemy of all machinery, especially electric generators. For the same reason the floor of the room is of flint tile of a light color, such as is used in many of the European stations. For the purpose of quiet advertisement the lower part of the front windows are glazed with one pane of plate glass 9 x 12 feet, which gives to the passing public an unobstructed view of the large room, electrical gallery and vertical engines. The windows are so arranged on pivots that all panes except the lower can be opened, thus affording the best circulation of air.

Under this room is a basement twelve feet in height, which contains all the piping of the plant. Under the front sidewalk is a vault twenty feet in height, into which are brought all underground and electrical gallery conductors. A portion of this vault, walled off from the rest, contains the air and oil circulating systems, and also a large space for storage battery plant, should one be installed in the future.

On the left of the engine and dynamo room is a driveway ten feet in width, connecting Union lane (at the rear of the station) with Pearl street. This driveway affords a direct passage for all coal and ash carts, the roadway being fitted with heavy cast iron tram or track to accommodate wheels of any size or width of gauge. Under this passage is a coal storage vault of a capacity of 650 tons of coal. This coal is fed into large tunnels extending under the entire building, and in which is located all coal and ash handling machinery. Over the driveway and opening out into the engine and dynamo room is the electrical gallery, on either side of which is a brick and iron enclosed ash receiver opening into the driveway below. On either side of these ash receivers is a room about ten feet square, the one in the front part of the building being set aside for the office of the chief engineer. This room has a window opening into the large engine and dynamo room, commanding a fine view of all the machinery. A doorway also opens out into a small platform from which stairs lead to the engine and dynamo room floor. The room in the rear of the building on the gallery floor contains a staircase leading to the next floor above, and also sufficient room for a "booster" plant.

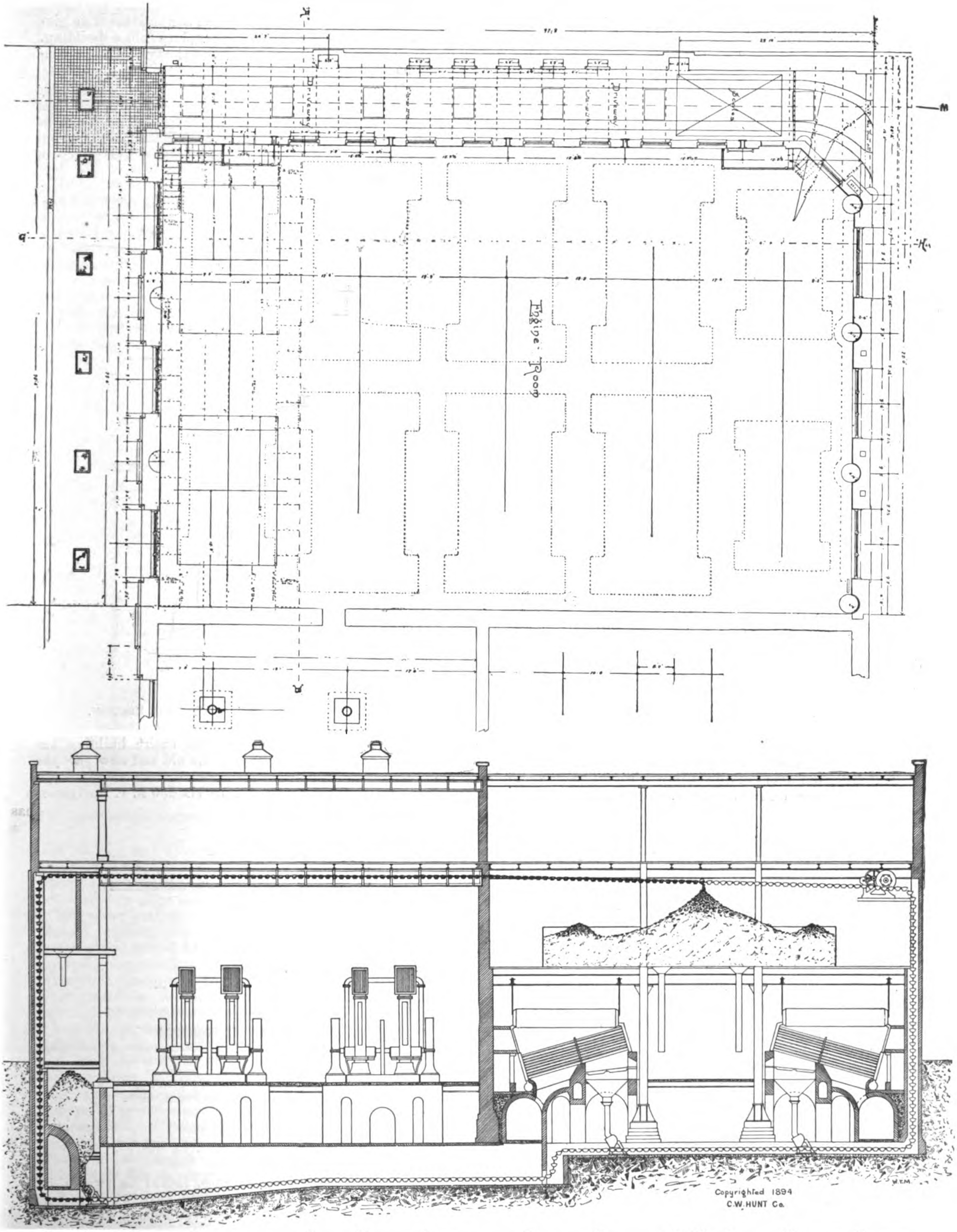


New First District Station of the Edison Electric Illuminating Company, Brooklyn, N. Y.—View in Engine Room.

The right of the building, comprising the old part of the station, will contain two floors of boilers with a capacity of 10,000 h. p. In the rear of this part of the building are located the two large brick chimneys, each 165 feet high.

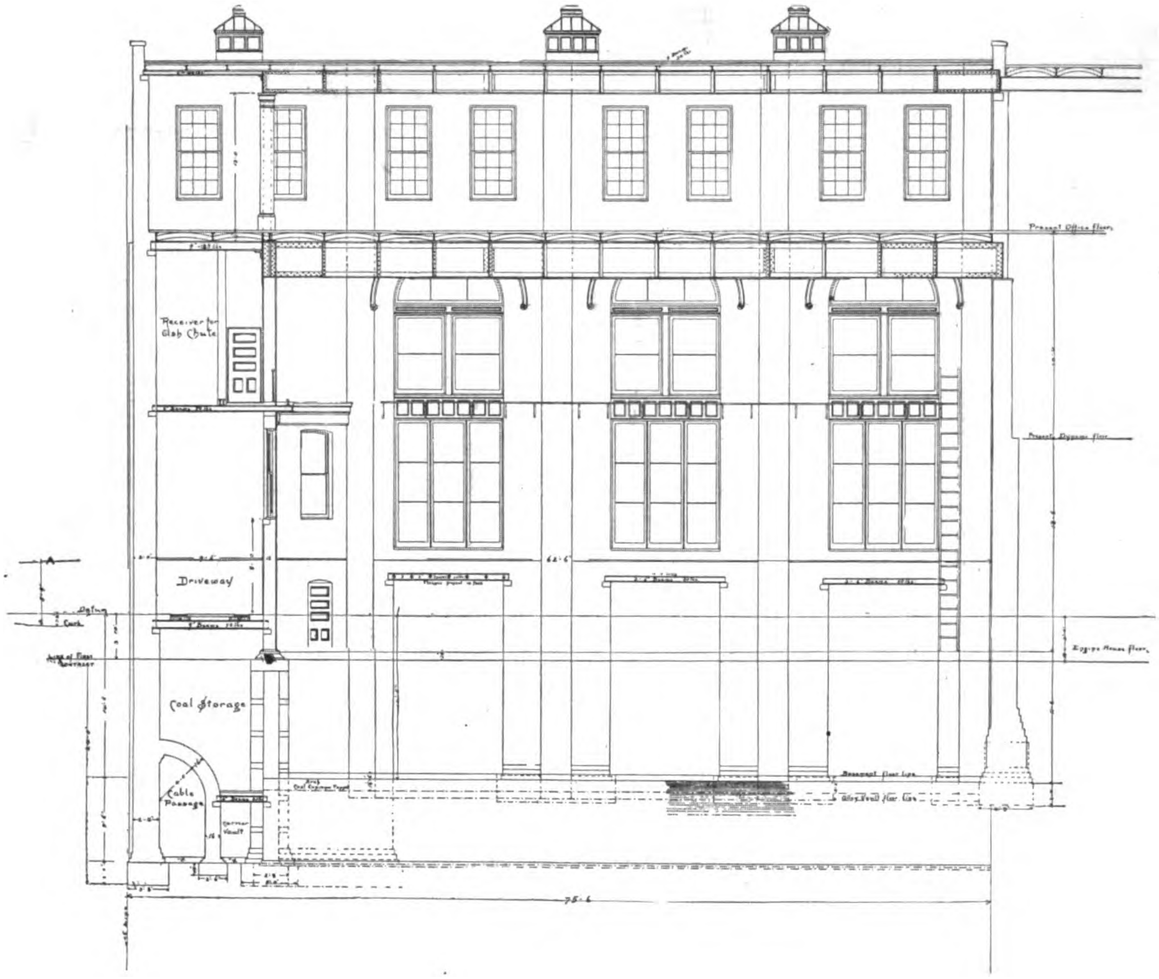
The entire top floor of the station is devoted to offices. These comprise the offices of the president, directors, secretary and treasurer, general superintendent, general office, counting rooms; offices of electrician, superintendent of steam plant, chief inspector, superintendent of underground, meter room, canvassers' room, testing room, emergency room, storerooms, machine shop, arc light room, toilet rooms, and extra space, left to accommodate future increase.

The station is absolutely fire-proof, the partitions of the office being of iron and plaster. The only wood used in the building is found in the window and door-frames, and a small area of flooring, almost all floors being of tile, iron, or cement. Care was taken in the design and construction

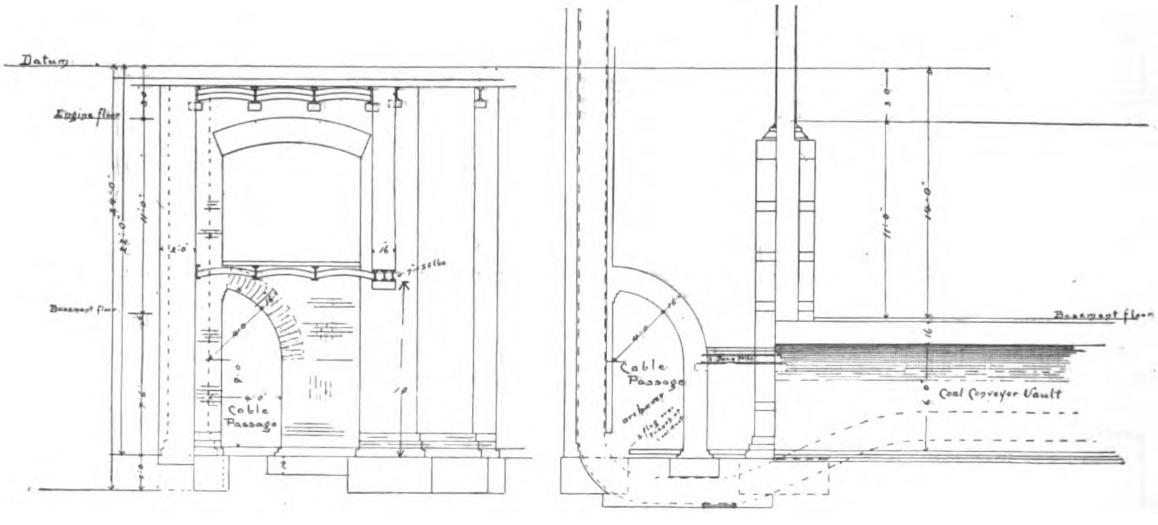


NEW FIRST DISTRICT STATION OF THE EDISON ELECTRIC ILLUMINATING COMPANY, BROOKLYN, N. Y.—GROUND PLAN AND SECTION SHOWING HUNT COAL CONVEYING SYSTEM.

of the building to provide, as far as possible, conduits for all wiring, and consequently the building is tubed for telephone, telegraph, call bells, light and power, and large accessible recesses were left for plumbing. The building on the sides and rear is protected by fire-proof shutters, and fire-proof doors divide it into sections, each containing a large water outlet and hose. Special care was taken in rendering floors and partitions of offices sound-proof, and particular attention was paid to the heating and ventilation. Thus is secured the advantage of having the offices in the main station of the Company, at the same time giving them all the benefits of a modern office building. Above the roof rises a tower about thirty feet high containing oil tanks. The front of the entire building has been slightly altered so as to give the old and new part the appearance of one building.



New First District Station of the Edison Electric Illuminating Co., Brooklyn, N. Y.—Vertical Section.



Details of Cable Passage and Coal Conveying Vault.

This station at present contains six 250 H. P. Ball cross-compound non-condensing engines, belted to twelve 100 K. W. Edison bipolar generators, and two 750 H. P. Lake Erie vertical cross-compound non-condensing engines, direct connected to two pair of 200 K. W. Edison multipolar generators. The Ball high speed engines are now being removed to another station and additional direct connected units installed, the estimated capacity of the plant being 12,500 H. P. nominal rating.

The boiler plant of the station is to be supplied by feed pumps connected direct to the vertical engines, the present steam pumps being used as reserve. These pumps are now being fitted to the two large engines at present installed and will be in operation within the next month.

In the erection of the new building an ample coal storage has been provided, in which can be carried a constant supply of 900 tons, an increase of 650 tons over the original capacity. In addition to this, machinery has been installed, so that coal can be delivered from the coal cart to the coal storage, and then distributed to the different boilers without manual labor; and by the same machinery the ashes are automatically disposed of. The capacity of the coal handling machinery, built by the C. W. Hunt Company, is 40 tons per hour, and this can be increased if necessary.

The new building has been equipped with a complete oil distributing and filtering system. By this means oil is transferred from the barrel to an elevated tank, and distributed through the engines, etc., of the station, and thence returned to a large reservoir, filtered, and again returned to the upper tank to be used over again. This is accomplished without any manual labor, although additional means are provided for oiling in case of trouble. A compressed air system is also used whereby air under 60 pounds pressure is distributed to different points of the building. This is used for cleaning the large multipolar generators, switch board, small oil piping, etc.

In addition to the plant described above, the company is operating a second and third district station, one of 1,000 H. P. and the other of 1,500 H. P. nominal capacity. Its Williamsburg or Third District Station is furnished with triple expansion condensing engines direct connected to multipolar generators. A fourth district is at present being supplied by "booster" and tie line system from the first, and the company is erecting a temporary plant of 1,000 H. P. to furnish current to the Buffalo Bill Wild West Show during the coming season.

In regard to the financial success of the company it is only necessary to state that this January its rate of dividend was increased from five to six per cent.

THE ADAPTABILITY OF AN EDISON THREE-WIRE PLANT.

BY

James Milne

THE electrical plant of the Incandescent Light Co. of Toronto, Canada, consists of two 200 K. W. direct driven, four 100 K. W. and six 60 K. W. belt driven generators of the ordinary Edison type, shunt wound for 140 volts. The company supply light and power on the Edison three-wire system at the usual pressure and also supply power to the electric street railway company at from 500 to 650 volts to supplement the power of the latter company's station. It is not necessary to describe the working of the three-wire plant as that system is well understood; but a short description of the switchboard as arranged at present together with its manipulation will not be out of place.

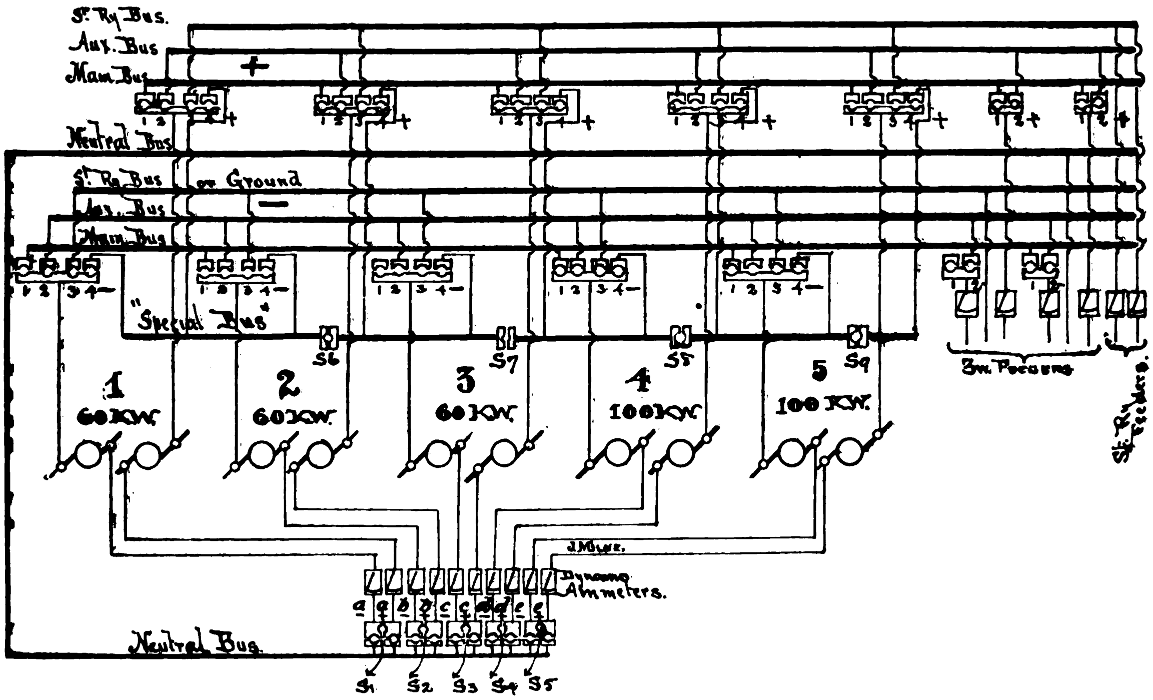


FIG. 1.—DIAGRAM SHOWING METHOD OF OPERATING 500 VOLT STREET RAILWAY CIRCUITS IN CONNECTION WITH THREE-WIRE SYSTEM.

The switchboard is arranged for running on two pressures and, by dividing the auxiliary bus, three different pressures can be run, this being necessary owing to the distribution of the load and the losses in some of the feeders at certain times. In re-arranging the switchboard for supplying current at 500 volts, it had to be taken into consideration that, for various reasons, the power could not be supplied by any particular set of dynamos, and also that the present three-wire system could not be interferred with, so that the generators could be switched in on either of the systems with the least possible delay.

The accompanying diagrams show how this is accomplished. As represented in Fig. 1, there are four switches on the + and — poles of each pair of dynamos, marked 1, 2, 3, 4, + and —, which are for the main, auxiliary, street railway and special bus bars, respectively. The object of this special bus will be seen later on. Suppose the two pairs of dynamos marked 1 and 3 in Fig. 1, are to be cut in on the street railway system: All the main and auxiliary switches on these machines, together with those leading to the neutral bus, are opened, thus cutting these machines entirely out of the three-wire system. All the machines are then brought up to the same potential and the switches s^1, s^3 (shown between the ammeters and the neutral bus) are closed. This has the same effect as closing the neutral switches, with the exception that the machines are not connected with the neutral bus. Switches 4 + on No. 1 dynamo and 4 — on No. 3 are now closed and connect the four dynamos in series through the special bus. Switch 3 — on No. 1 generator is next closed and connects the — pole of the series with the ground. All that now remains to be done to connect the generators with the street railway circuit, is to close switch 3 + on No. 3 machine. Before doing this, however, care is taken to have the pressure of the series of generators exactly the same as that of the street railway bus, which is ascertained by the voltmeter or galvanometer as in common practice.

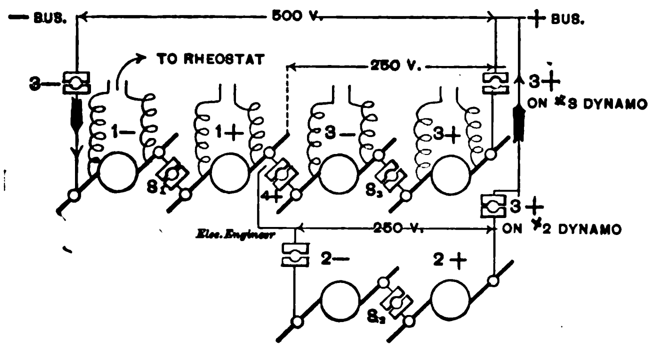


FIG. 2.

The arrangement of the dynamos in the series is shown in the upper portion of Fig. 2, the switches being lettered so as to correspond with Fig. 1. When two pairs of dynamos are running in series and it is necessary to cut in another pair to replace one of them, Fig. 2 shows the method adopted so clearly that no description is necessary. Two 100 K. W. generators can be easily switched in and the load transferred from the two 60 K. W. generators, the only precaution necessary being to have all the machines doing as nearly as possible the same amount of work.

Fig. 3 shows four pairs of dynamos in series-multiple supplying current at 500 volts and one pair supplying current to the three wire system as well. One pair of the 100 K. W. dynamos is generating 400 amperes at 250 volts and the other pair is generating 700 amperes at 250 volts. Each of the latter pair is, therefore, supplying 300 amperes at 125 volts to the three wire system while connected with the 500 volt system. This is simply a modification of the five wire system and has given excellent results. The writer was somewhat dubious as to the successful operation of this last method, but, as the load at 500 volts is remarkably steady, it was found that the variation in the pressure was so slight as to be unobserved in the lights. The only objection to this arrangement is that the negative side of the three wire system is grounded, but this in itself is not a matter of importance if the rest of the system be clear.

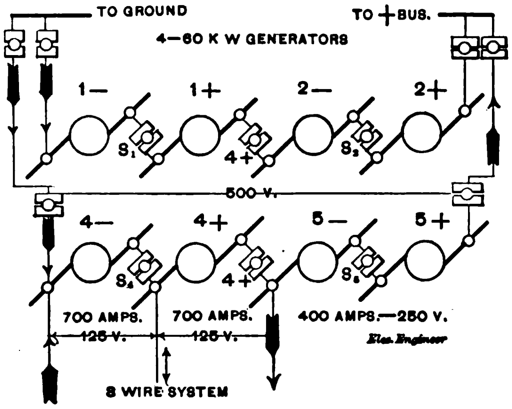


FIG. 3.

By referring to Fig. 1, it will be observed from the arrangement of the special bus that any pressure from 125 to 1,600 volts can be obtained. The latter pressure can be obtained by opening the switches s^6, s^7, s^8, s^9, and connecting all the ten dynamos in series. As there has been no occasion to run at 1,600 volts, the writer cannot say how this would operate, but from the very satisfactory results at 500 volts, it does not seem probable that there would be any difficulty in running at higher voltage.

THE COPPER-ZINC ACCUMULATOR.—V.

BY

Dr Paul Schoop

The diffusion of the electrolyte, that action that constantly brings fresh parts of the electrolyte up to the active material, becomes slower when the temperature falls. In the case of the caustic potash solution, as used with the copper accumulator, it is found, that, near 32 degs. F., it has quite an oily appearance and flows out very slowly through an opening of even ⅛ of an inch diameter. The capacity depends also upon the rate of the charging and of the discharging current. With lead accumulators, this varies to some degree according to the construction of the plates. As a rule, the more porous the active material is, the less is its capacity affected by different rates of charging or discharging currents. At comparatively high temperatures there is not so much difference as at lower temperatures; but, since dilute sulphuric acid (1 part pure acid to 4 parts of water) is still very liquid even near the freezing point, the capacity is not decreased to any serious extent even when a large discharge current is applied. But it is not so with the alkaline accumulator, which yields but a small fraction of its normal capacity under such circumstances. This is of course only of theoretical interest, since in practical service the temperature of the battery would not be allowed to run down so far. It was to be expected and experiments have proved it, that, other things being equal, if a good circulation of the electrolyte is set up, the same cell will yield a larger capacity. With the lead accumulator (pasted plates) about 15 per cent. more capacity is obtained, if the acid is kept in circulation instead of remaining at rest. A considerable gain in capacity is also obtained with the copper cell by providing for for good circulation of the liquid.

There is also the *Local Action* to be considered. As in the case of the lead cell, it is dependent upon the temperature and is slowest at low temperatures. If a lead cell stands idle after having been fully charged for several months during the winter in the open air, it will be found to contain after that time still ¾ of its regular capacity. In summer, as many weeks will suffice to bring the capacity down to ¾. The zinc in the charged alkaline cell is also attacked by the electrolyte and hydrogen gas is slowly evolved. In order to avoid great local action between the steel sheet acting as a support for the zinc, and the latter, the sheet must be well amalgamated with mercury. For this purpose, Desmazures adds mercury to his electrolyte. But even then, owing to the great surface of the support and the liability of the zinc to take up oxygen at practical temperatures, the zinc deposit does not last for nearly as long a time as the spongy lead in the lead-cell. In traction work there is no opportunity for storing up electric energy for a longer period than 24 or 48 hours, and during that time local action does not come into account so much.

During the *discharge* of the copper cell, too great currents must be avoided and to short circuit a cell is not advisable. As has been set forth in a previous article the oxygen goes to the zinc when current is taken from the battery. Whether oxide of zinc is really formed first and immediately afterwards dissolved by the caustic potash solution, or whether the zinc at once enters into some bodies formed electrically at its surface and thus dissolves, is immaterial for the present. The fact remains, that if too strong a discharging current be applied, the zinc does not dissolve readily and smoothly, but some oxidized zinc compound is found on the electrode whose dissolution is more difficult to accomplish; still, the copper cell stands pretty high discharges.

The Charging of the Alkaline Accumulator.—The charging current depends on the following factors: 1. Amount of zinc contained in the electrolyte. 2. Rate of circulation of the electrolyte. 3. Area of the cathode. 4. Composition of the electrolyte. 5. Temperature of the liquid. 6. Continuity or discontinuity of the charge. 7. General construction of the cell and electrodes.

If we investigate the conditions of charging in a lead accumulator, we would find the same conditions to govern, but it does not so much matter whether certain conditions are exactly fulfilled or not. When a lead cell contains very dilute acid, say, only about 10 per cent. pure acid, and if a comparatively large current is used for charging, at a low temperature, one finds that not half as much energy is taken up as when the same cell is charged under more favorable conditions, at a moderate temperature (70 degrees F.) with an electrolyte containing 30 per cent. of pure acid and with a rate of current calculated for a charge during 10 or more hours.

The alkaline solution must contain as much zinc as possible. For this reason, the solution of caustic potash must itself be very concentrated, since dilute solutions do not take up much zinc. If such a well made zinc solution is diluted with water or heated, part of the zinc is precipitated in the form of white oxide of zinc. It is advisable,to have the liquid circulate during the whole time of the charge. To charge with a constant current is not advisable, since at the beginning there is the maximum of zinc contained in the solution and at the end of the charge so much less as has been deposited on the cathode. Therefore the charging current must be reduced accordingly. An addition of a colloid substance (as in Mr. Swan's experiments on the deposition of copper at high current densities) has a good effect on the zinc deposit. Moderate temperature (between 70 and 100 degrees F.) is best for the zinc deposit. To charge intermittently, that is, first charge, then rest, then charge, and so on, gives better results than continuous charging. A network of steel wire is preferable to anything else as a support for the zinc. The porous copper ought to be in as much and as good contact with the copper support as possible.

ELECTRIC TRANSPORTATION DEPARTMENT.

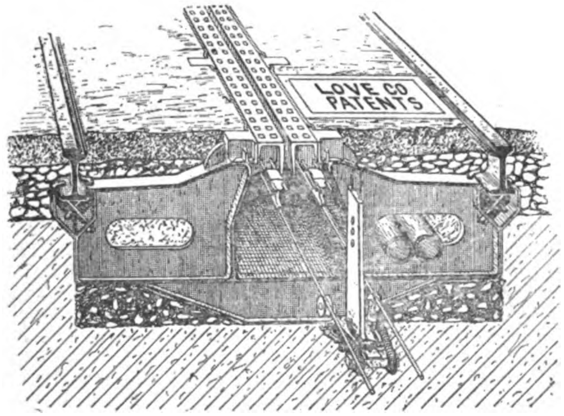
THE LOVE CONDUIT SYSTEM.[1]

BY M. D. LAW.

The Love underground trolley system in Washington is a perfect success in every particular. The cars were started March 2, 1893, and have run successfully since the current was turned into the line. The only delay occurred on June 22, when some of the strain insulators gave out from heat. They were changed to others of special make, that have extremely high insulation of pure mica, will stand 250 degrees of heat, and break at 7,680 lbs., far above anything that is required of them. There has not been five minutes' delay, from any line trouble, since they were put in.

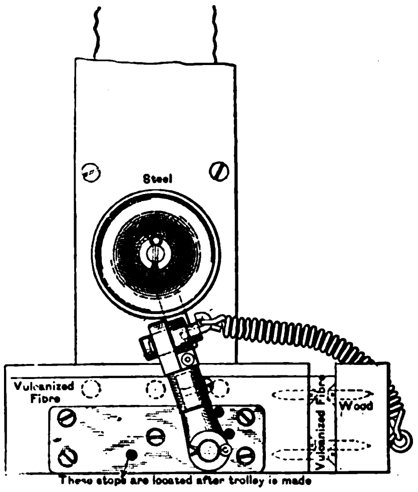
None of the line insulators have ever given out, either here or in Chicago, where the road has been in operation twenty-three months, nor do any of them show any signs of deterioration.

There has been a great cry from electricians all over the country, that trolley wires could not be operated underground, in an open conduit, for the reason that it is subjected to so much moisture, mud and slush; but I have found that, with the wire properly protected, there is no moisture on the insulator, as I have taken up the slot rail, in the worst of weather, and found the insulators dusty.



THE LOVE CONDUIT SYSTEM.—SECTION.

The success of the Love system comes from the fact, that the insulators and line are thoroughly protected, under a U-shaped slot rail, which forms a perfect steel overcoat for them, and the long lip of the slot-rail extends down far enough to carry all slush and mud below the wire and takes all the blow from the trolley, in case of the derailment of a car, so that the line cannot be injured.



THE LOVE TROLLEY AND CARRIER.

The insulator is so placed under the slot-rail, that there is a free circulation of air around it at all times, and, as there is a strong draught through the conduit, it keeps the air constantly moving.

There has never been any indication of leakage by the ammeter test, although there have been many severe storms, of both snow and rain. There has been no delay during these storms, while the overhead line has been shut down for hours at a time from line trouble.

The other principal feature in the Love system, is the trolley and its carrier. The former is an ingenious mechanical device, having all the movements of the human arm, which allows it to readily follow the wire and is so adjusted, that it will run either forward or backward.

The trolley carrier is so arranged, that the leg of the trolley is at all times held in the centre of the slot, and prevented from binding when rounding curves.

On the Washington line there are three curves, two crossovers, one double track cable crossing and three double track street car crossings. The curve at 18th and U streets is a very sharp compound curve on a two and a half per cent. grade; but there has never been the least difficulty with it.

The Love Electric Traction Co. deserve great praise in the developing of their system, for it has been done under great difficulties, and from the start nearly all electricians and engineers have been against them.

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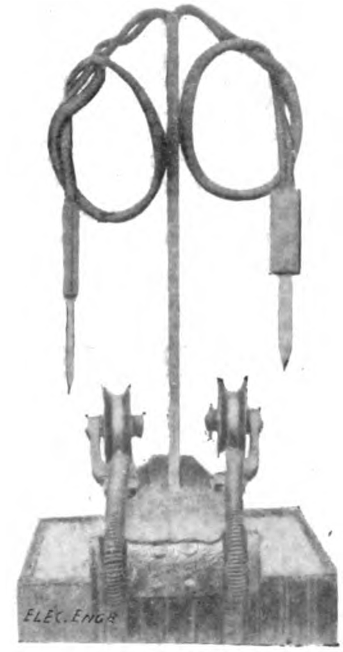
[1] See THE ELECTRICAL ENGINEER, Sept. 21st, 1892. We are indebted to the *Railroad Gazette* for the outline cuts illustrating this article.

The Chicago road was the first one built and is a grand success, when it is considered, that no plan or model of it was ever made, and that it was built in the winter, when the thermometer was below zero, while the contract stipulated that it must be run successfully for three months without skilled labor. The fact that at the end of the three months the railway company accepted the road and paid for it, is good evidence that they considered it successful. They have also given written testimonials that they are entirely satisfied with it.

The Washington road is the second effort, and is built in every particular as it was planned, nor has it been necessary to change it in any way. The president of the Rock Creek Railway Company testifies under date of January 12, of this year, that he is entirely satisfied with its operation, and considers it a perfect success. The company also testify, that they are confident that it can be operated, as cheaply as, if not more cheaply than, the overhead system.



THE LOVE UNDERRUNNING CONDUIT TROLLEY.

A trip to Washington will show that nearly every resident is a friend to the underground trolley system.

THE MOORE MAXIMUM SPEED STREET CAR INDICATOR.

BY D. MCFARLAN MOORE.

THE passage of laws and city ordinances regulating the speed of street cars has developed the necessity for a simple automatic device which will notify the motorman, conductor, passengers, and, if thought advisable, the police and public, whenever the lawful speed is exceeded. The probability that the adoption of such a device will be made compulsory by law makes it doubly valuable.

This object can be accomplished by a great variety of means —gears and pinions, fluids, electricity, levers, governors of all kinds, various braking devices, bells, &c. The adoption, therefore, of any particular form is merely a matter of expediency, when all conditions are taken into consideration. But the demand is restricted not to an instrument indicating various speeds but to one indicating a definite speed, beyond which the car should not travel. However, if desirable, the device herewith illustrated can be modified to indicate with one adjustment any number of speeds, by the addition of an equal number of adjustment screws and bells of various tones, or an indicating dial.

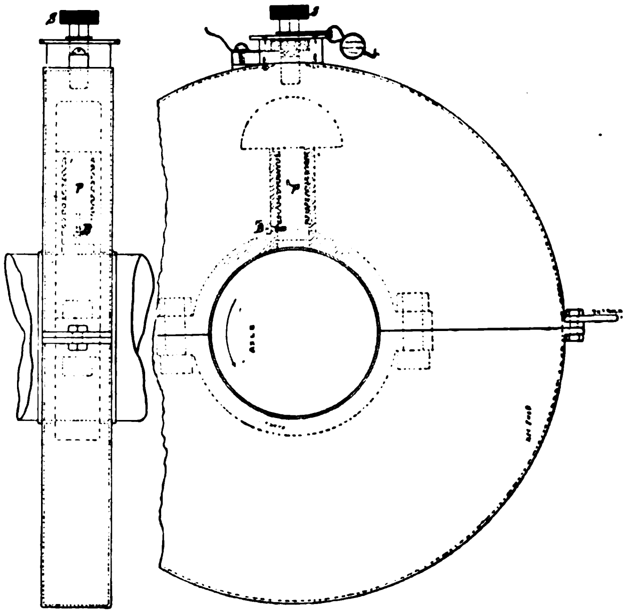
The salient points that should receive attention in the design of a machine of this nature are,—practicability of the fundamental principle of the device with special reference to misadjustment; ease of application to a car under all circumstances; minimum of space and weight required; ease of regulation; amount of attention necessary on account of mud, dust, bearings, oil or grease; durability; effect of car running in either direction; and last but not least, cost.

Electric bells in connection with a simple form of centrifugal contact device, therefore, would seem to be the best solution of the problem and the sound of bells or some other acoustic device placed on either one or both of the car platforms would indicate in a positive and unmistakable manner that the law is being violated.

The contact device in question is placed on the axle immediately between the wheel and the motor. It consists of a light cast iron gear case about 10 inches in diameter with a 1½ inch face, secured to the truck upon the axle, Figs. 1 and 2. Inside of this case is clamped a collar, from which projects radially a short pipe containing a spiral spring and plunger which makes the desired contact when acted upon by centrifugal force, varying with the speed of the car. Since the tendency of centrifugal force is tangential, the slight liability of the plunger P not working freely can be obviated by pivoting the radial pipe so that the head of the plunger can move in a short arc of its own. The proper adjustment is accomplished by means of a milled-head screw S projecting from the face of the case. This screw is accurately adjusted and sealed by an inspector, for a given speed. Should the speed of the car become much greater than that adjusted for, the ringing would be rapid but no damage would be done. This is prevented by a screw attached to the plunger and working in a slot in the pipe, which also prevents the plunger from revolving on its own axis. The contact, therefore is not injured, and the tendency of the rotary motion is to keep it clean. As the light cast iron case bears upon the steel axle it requires but little lubrication and is held in place and prevented from revolving by attaching it to the car truck.

One small wire electrically connects the adjustment screw with the bells, the current being supplied either from a battery or the trolley line.

Since the axles of street cars running at ten miles per hour with 30 inch wheels make 111 rev. per minute, it will not be necessary or advisable to use vibrating bells. Each stroke therefore will indicate one revolution beyond the maximum speed and rapid ringing will mean much too rapid traveling.



THE MOORE MAXIMUM SPEED STREET CAR INDICATOR.

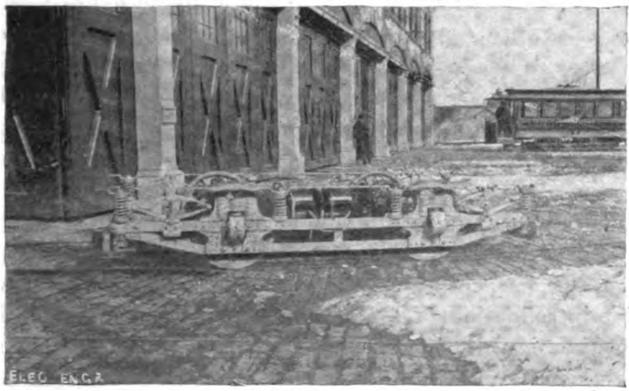
A NEW ELECTRIC LINE FOR ILLINOIS.

The Rock River Electric Railway Company, has just been organized with a capital stock of $500,000. It is proposed to connect Rockford and Dixon, thirty-eight miles apart, with an electric line, as soon as spring opens. The estimated cost of the line is $10,000 per mile, and the company propose to do a general passenger, express and mail business, and later on to handle freight. The line will be operated by water power, Fred G. Jones, of Oregon, and Jamison C. Ayers, of Dixon, two of the incorporators of the company own a controlling interest in the water power of Rock River in those cities.

The company's charter runs for fifty years and the first officers are: President, James S. Ticknor; secretary, Harry B. Andrews, and treasurer George B. King. The route is a most feasible one, the Chicago and Northwestern Railway Company having surveyed it three times with the intention of building a steam road to make closer and quicker connection with the main line at Dixon. The electric line has the advantages that the cars are able to turn sharper curves and climb steeper grades.

THE WINKLER TWIN SERIES MOTOR IN NEW YORK.

In our issue of Jan. 3 we described and illustrated the ingenious "Twin Series" motor designed by Mr. C. F. Winkler, electrician of the United Columbian Electric Co., in which two armatures revolved in magnetic fields so as to make but a single magnetic circuit. The advantages of this system were fully pointed out in that article and recent practical work seems to have confirmed them fully. Among the roads on which the Winkler motor has been put in operation is the Union Railway of New York City, one of the most influential street railroads in the country, who are making a practical test of the Winkler motor with the view of ascertaining accurately its economy and various other advantages for street railway traction.

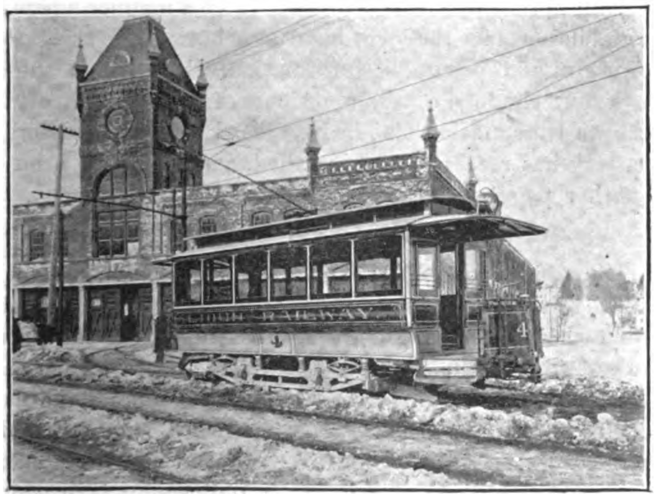


The Winkler Street Car Motor.

The United Columbian Electric Company have equipped a standard 18-foot car with its 50 h. p. motor and controlling mechanism, and mounted it on a Peckham flexible gear truck. The accompanying engravings, Figs. 1 and 2 show the truck and motors and also the completed car as now operating on the Union Road on the other side of the Harlem River. We hope to publish shortly some tests on the relative economy of this and other equipments.

The "Twin Series" motor bears out in actual service all that has been claimed for it as regards economy, flexibility and the ease with which it rides round the sharpest curves. It is also claimed to be considerably less in weight per actual horse power than any other double equipment. One of the most remarkable features of the car is the very slight diminution of speed when ascending a heavy grade.

The controlling mechanism includes a short-circuiting device for use as an emergency brake in case of danger and which will bring the car to a sudden stop without taking current from the line or causing the fuse to blow; in fact when this device is operated the trolley is cut out automatically and it is not even necessary for the motorman to wait to throw off the controller, as the device will operate equally well with the controller full on. Usually when the motors are reversed to stop the car the overload will either open the circuit at the power house or blow the fuse on the car, as in the recent terrible accident in San Francisco, and the motorman is then helpless. If in this case the car had been equipped with Twin Series motors and this device, the accident could not have occurred.

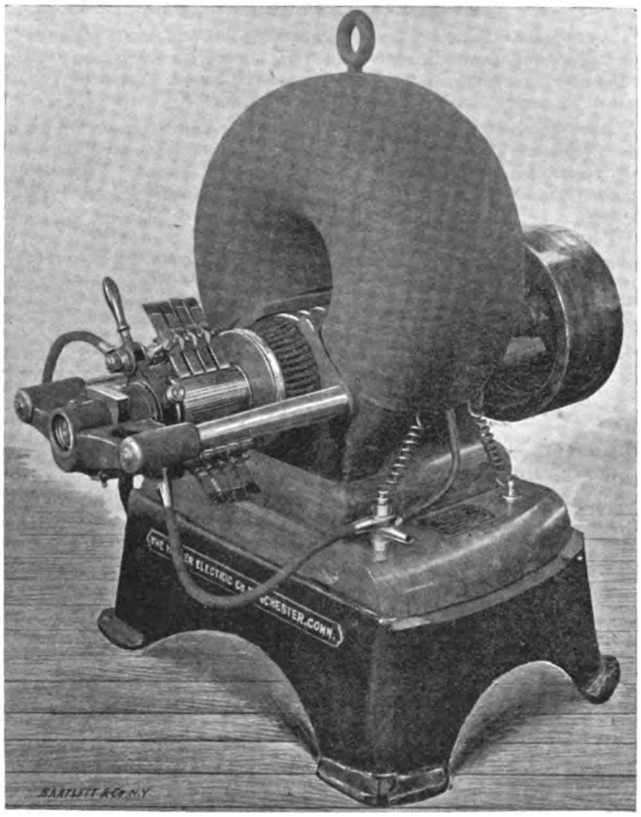


The Winkler Street Car Motor, Union Railway, New York.

THE NEW MATHER RING POLE DYNAMO AND STREET RAILWAY GENERATORS.

The Mather machines are too well known to require any detailed description but some recent improvements in the machine are well worth describing. Principal among these is the adoption of steel instead of cast iron for the field magnets. Owing to the greater magnetic permeability of this material the output of the Mather machines has been nearly doubled and their speed reduced. The accompanying engraving represents the a 31 k. w. machine of the new type, designed for 500 lights and running at 850 revolutions. The armature of this machine is surface wound, but the larger machines have toothed armatures.

Among the mechanical improvements we note a change in the self-oiling bearings. These are now constructed in such a manner that the height of the oil in the reservoir below the bearing can be readily inspected; this prevents waste of oil in filling and affords a means of watching constantly the supply of oil. This type of machine is built in various sizes up to 1,200 lights capacity.



The New Mather Ring Pole Dynamo.

As already announced by us the Mather Company has started up its plant on full time and besides its regular line of machines is actively pushing the construction of twenty-five of its new 120 k. w. street railway generators. Mr. Thomas C. Perkins, the vice-president of the company is very hopeful of the future and will represent it at the Washington Convention of the National Electric Light Assoication.

It will be the policy of the Mather Company to confine its business strictly to that of a manufacturing company, working for a manufacturer's profit and selling its machines on an independent basis to contractors, central stations, etc. Messrs. G. M. Angier & Co., of No. 116 Bedford St., Boston, are contractors for the Mather apparatus in New England.

The C. & C. Electric Motor Co., who have recently removed their works to Garwood, N. J., have now removed their old office in Greenwich street, to No. 143 Liberty street, New York.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - -	per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	" €	5.00
Single Copies, - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XVII. NEW YORK, FEBRUARY 28, 1894. No. 304.

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STORAGE BATTERIES IN CENTRAL STATIONS.

THE chief object of the meetings of the National Electric Light Association is the discussion of topics which will enable the members of the Association to learn the experience of others and to profit thereby. It seems eminently proper therefore that one of the subjects which should be taken up is that of the introduction of storage batteries into central stations. It might be said that our experience in America has been too short and too meagre to permit of a discussion such as those usually indulged in at the Association's meetings, but if the subject is brought up even in a more general way it will serve the purpose of demonstrating prominently what, we believe, will be standard practice not many years hence. "How can we equalize that frightfully variable load extending over 24 hours?" has been the sigh of station managers for years. The introduction of motors has, it is true, helped to bring up the day load, and the rapid multiplication of arc lights on incandescent circuits has increased the night load, but with all this, there are but few stations whose load diagram does not resemble strongly the familiar saw-tooth. Up to the present, the central stations equipped with storage batteries in the United States can be counted upon the fingers of one hand, while in Europe there are over 175 stations equipped with batteries varying in capacity all the way from a little over 100 to over 3,000 ampere hours. We are well aware that not all American electrical engineers are agreed on the economy of the central station storage plant; but, we ask, can it be possible that the foreign engineers would continue this practice unless it had proved economical in the past, and especially in view of their well known conservatism in all such matters? We are not unmindful of the deterring effect exercised throughout the past by the long and wearying litigation in this field, and regret to note a renewal of warfare; but in spite of all this it seems hard to reconcile all the facts in this apparently studious neglect of the storage battery, except on the theory of lack of knowledge. If the members of the National Electric Light Association can find time to devote to the subject and to treat it in a manner adequate to its importance they will have added largely to their stock of useful and profitable information. We would submit as a text the load diagram of one of the stations of the Edison Illuminating Co., in New York, in which a storage battery has recently been installed, and which we print on another page.

TELEPHONE AND TELEGRAPH.

Superficial observers, and even trained students who are cognizant of the slow effect of new ideas in other fields than that of invention, are apt to assume that the net result of an invention, if it succeed, is destructive rather than constructive. In other words, they believe that the new-comer in order to make a place for itself has to shoulder something else out of the way, because there is not standing room enough for both. Such philosophy is certainly wrong. The list of old things that have disappeared under the competition of the new, is not at all extensive; hardly as long, we should say, as the list of old things to which in some unexpected manner the later ideas and influences have given a renewed lease of life. Perhaps the number of dugouts, bows, tinderboxes, sandals, and tents is not on the increase, but aside from these and a few like instances, old forms continue to perpetuate themselves indefinitely and in larger variety and quantity than ever. What is chiefly done by important innovations is to define more strictly the limits within which the ancient can be genuinely useful and efficient. That is about all. Sailing ships still swarm the seas despite steam; gas is burned in enormous quantities without material check from the rapid introduction of electric light; and there are as many tents and canoes in use to-day for pleasure as were known even when the Tartar roamed Europe or the Red Indian owned these Western waters. The telephone has made gigantic strides these ten years, but there is more telegraphy than ever, and no sign is discoverable of falling off in the number of mailed letters or messenger boys.

That the telephone should environ the telegraph with a larger area of utility one can readily understand, but such observers as we have in mind may be unwilling to believe that the telephone can actually stimulate the telegraph. Yet such is undoubtedly the case, when the matter is viewed broadly. Our own conviction on this point received an unexpected support in the remark of a shrewd electrical manufacturer recently. In conversation on the subject of the better outlook for universal telephony through the running out of the monopolistic early Bell patents, he said that the sales by his house of telephones had, very curiously, been accompanied by almost as large orders for keys and sounders. The idea of the purchasers was that if they were going to put up a line, they might as well have keys as telephones at each end; and thus the lines are being rigged up everywhere "contrived a double debt to pay." It might be said that this touches only a smaller branch, but the practice here indicated will, we venture to assert, sooner or later be carried out on the largest scale, in heavy work.

PAYING STATIONS.

We are glad to give space in this issue to a letter from Mr. W. N. Stewart called forth by our recent editorial on his paper read before the Northwestern Electrical Association. Mr. Stewart takes exception to the doubts we have expressed as to the entire correctness of his conclusion that direct current stations are the best payers, and brings forward additional statistics of stations in the State of Wisconsin to prove his case. These are valuable in so far as they show a condition of affairs which ought to be susceptible of remedy. There are so many factors governing the paying qualities of a station that it would be futile to ascribe the causes of a non-dividend paying condition to any one of these factors. This Mr. Stewart practically admits and we think that he has struck the keynote to the situation when he refers to the personal equation of those operating the plant. The best equipped station in the world would lose money with bad management, and in the management we include not only the electrician but everyone connected with the operation of the plant from the president of the company down to the fireman; while on the other hand we know of stations having apparatus built ten years ago, which are earning money for the stockholders. If it be true "that the average country electrician cannot get the best results out of his apparatus," then it is high time that the "country electrician" be retired and his work be put into the hands of those who *can* get the best results out of the apparatus. We discern in this state of affairs an opening for many of the graduates of our electrical engineering schools. These have for the most part gone into the drafting rooms and laboratories of electrical concerns until the demand in that direction appears to be pretty well filled, and the bitter experience of the last few months has served to emphasize this fact of surplusage of such talent in a most striking manner. If more of these young men, well equipped as they are, would start out after graduation with a view to fitting themselves for the management of central stations we believe that more of them would find congenial and profitable employment, and the public would soon hear less of the non-paying qualities of stations. The time has passed when it seemed to require the massive brain of a heaven-born genius to design a dynamo; and we would suggest that a fair amount of time be devoted in our electrical engineering curriculums to central station management and finance—a need which we are glad to note has been recognized recently in several colleges.

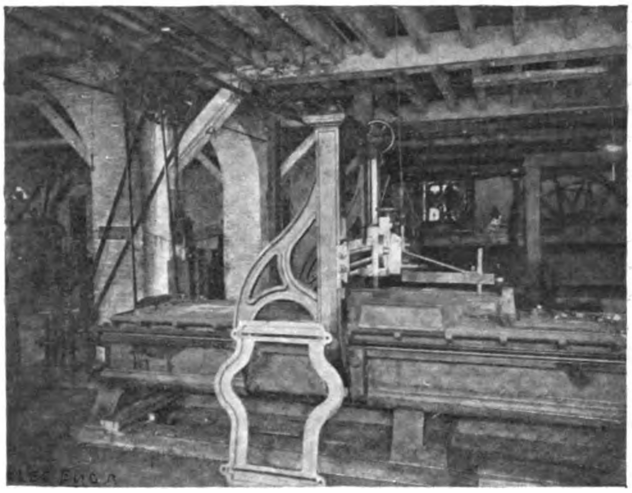
ENCLOSED HIGH-POTENTIAL ARCS.

The electric lighting fraternity throughout the country has been anxiously awaiting the results of commercial tests of that latest development in arc lighting, the Howard system, in which the arc is enclosed in a small bulb so arranged as to practically exclude the external air. We have already referred to the importance of this very interesting device to the arc lighting industry and have recently noted the practical tests on the circuits of the Hartford Electric Light Co., where the system has now been adopted. It is safe to say, therefore, that among the numerous topics laid down in the programme of the National Electric Light Association's meeting at Washington none will excite keener interest than the report to be presented by ex-president C. R. Huntley, of Buffalo, embodying the results of his own exhaustive tests of the system. Since the time of the presentation of this subject at Chicago before the International Electrical Congress last August there have been, we hear, several important improvements in the design and action of the Howard device. It is said that one change in the construction has resulted in prolonging the life of the electrodes nearly 100 per cent. Indeed, we understand that recent tests show the life of the negative carbon to be over 200 hours per inch! But the great field for the enclosed arc lies in its application to constant potential circuits, direct and alternating currents. Mr. L. B. Marks, who with Mr. L. E. Howard has been identified with the development of this system, has just devised a method of running high potential arcs on high potential circuits, and which promises to open a broad and entirely new field in electric lighting. His plan is to run 100 or 110 volt arcs directly across constant potential circuits without the intervention of dead resistance; he is thereby enabled to decrease the current to 2 or 3 amperes and without impairing the value of the light. It is obvious that results of this character are practically impossible with open air arcs, and hence they would seem to bear out our prediction that the arc-enclosing cylinder must have a wide and deep influence on the future of arc lighting. We trust that the convention will discuss and investigate this matter very thoroughly.

THE LA ROCHE ELECTRIC WORKS, PHILADELPHIA, PA.

I.

LARGE industries very rarely spring into existence fully equipped and well backed. They and their founders have literally to work out their own salvation with fear and trembling. In electrical development this has been, and is still, painfully true. When the history of the electrical industry in America shall some day be gathered into a volume adequate to do it justice it will be found that the majority of the large and successful concerns now in existence were the outgrowth of the individual efforts of poor and struggling inventors—of men who, in addition to the hard work of thinking out new ideas and constructing their apparatus and devices with their own hands, had the still harder task of convincing the public of their utility and the capitalist of their paying quality as business enterprises. Among those pioneers who have had to do battle with such fearful odds was Mr. F. A. La Roche, the founder of the La Roche Electric Works, of Philadelphia, who from the smallest beginnings in 1880 has succeeded in creating a business now requiring for its handling a seven story building covering several acres of floor space, and equipped to build machines up to 10,000 lights capacity. Postponing for the present a narrative of the interesting history of the La Roche company we shall at once take up the description of the new works which the company have just acquired and equipped for the manufacture of all kinds of electrical machinery, including a special line of alternating current apparatus, direct current machinery for incandescent lighting, power generators, railway motors, arc lighting apparatus, and a variety of accessories such as switchboards, measuring instruments, etc.



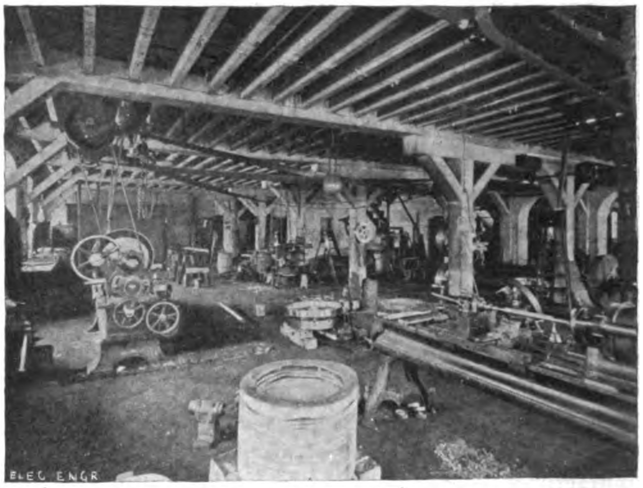
Heavy Planer Driven by Electric Motor.

II.

The new works, facing on American, Diamond and Bodine streets, Philadephia, are seven stories high with a frontage on Diamond street of 120 feet, and on Bodine street of 116 feet. The building is substantially built, with 30 inch walls and is one of the largest factory buildings in that section of the country.

Descending to the basement or first floor the visitor's eye first meets the power plant which consists of three 125 h. p. engines and one 25-h. p. engine. One of these drives two direct current generators, one alternator and an arc light machine. The direct current generators furnish power throughout the works, as all the departments are run with individual motors, no belts of any kind passing through the floors. Where a number of machine tools are grouped, a small countershaft is placed overhead, driven by an electric motor. The small 25-h. p. engine is used for lighting the office, etc., after 6 o'clock p. m., when the main plant is shut down. The two remaining engines are used for testing purposes and are so arranged that any one of them, or the combined power of the three, can be concentrated upon one generator, thus giving a total capacity of 400 h. p. There are in all four boilers of 125 h. p. each, one used for heating the building and the remaining three for power purposes.

On the same floor is the blacksmith shop where all the heavy machine work is done. There is also considerable heavy brass work done on this floor as some of the brass spiders and shields used in the 5,000 light alternators are turned up and finished in this department, extra large lathes and tools being required to handle these large diameters. On the same floor, one of the large planers, as will be seen, is run by an individual motor.

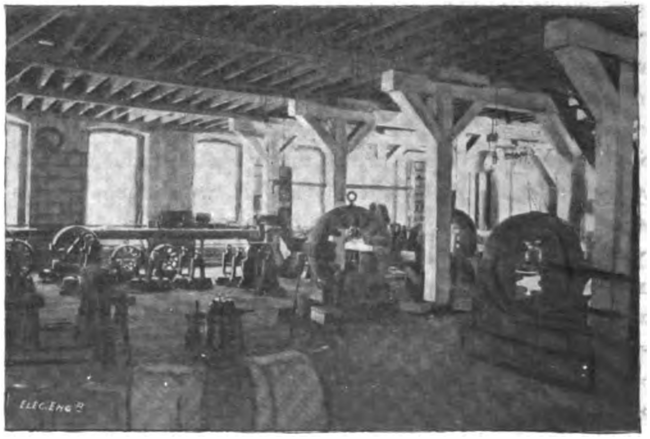


Heavy Machine Department in Basement.

On the second floor is the erecting, assembling and testing room where a number of both large and small direct current machines and alternators are in course of construction. The stock room is also on this floor. In the stamping department will be noticed a large stamping press where the armature discs are cut and stamped, and also insulated and assembled.

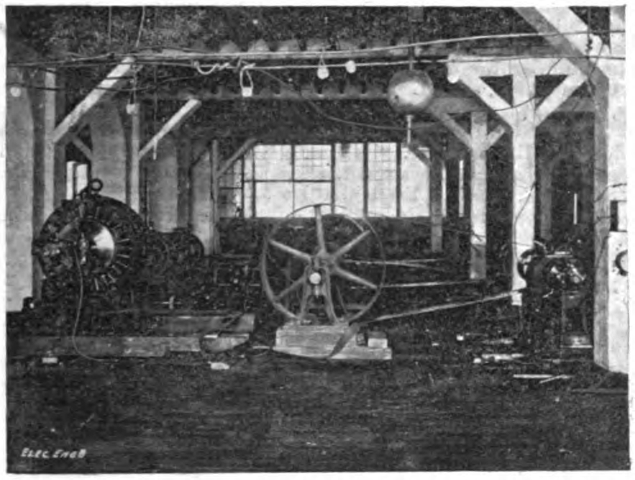
III.

The La Roche alternating armatures are of a novel and ingenious construction and are so arranged that any number of coils up to one half the total number may be burned out or affected from any cause, without interfering with the running of the machine at full load ; and in case of such an accident, repairs can be made in a very short time. A toothed armature is used for all alternators of 500 lights capacity or over, and a smooth armature for all machines under that size. They are of the laminated type, made of the best Norway iron, insulated with specially prepared paper. On the 2,600 light machine, the armature is bolted together with 27 bolts. The grooves of both armatures are of a new design and exceedingly shallow, insulated with asbestos and the best grade of mica, making them practically fire and water proof. No rectifiers or commutators of any kind are employed in the La Roche machine, but simply two collector rings ; the regulation is entirely automatic, no outside controller of any kind being required.



Assembling Department.

The armature which is mounted upon an extra heavy steel shaft ground to gauge, is absolutely iron-clad, and no wires show when it is completed. It will be noticed that the machine is so built that the frame or ring is cast in two separate parts so arranged that the top half can be lifted and any field coils removed and replaced. Another advantage claimed by the manufacturers is that it is not necessary to remove the armature or any portion of the machine to insert a new coil in the armature. The end of the armature is protected by a brass shield which is carefully insulated and where the leading in wires cut through they are insulated with micanite and hard rubber bushings. The collector rings are mounted upon an individual sleeve and arranged so that either one or both rings can be removed in a short time. All the La Roche machines are equipped with ball and socket, self-oiling bearings.



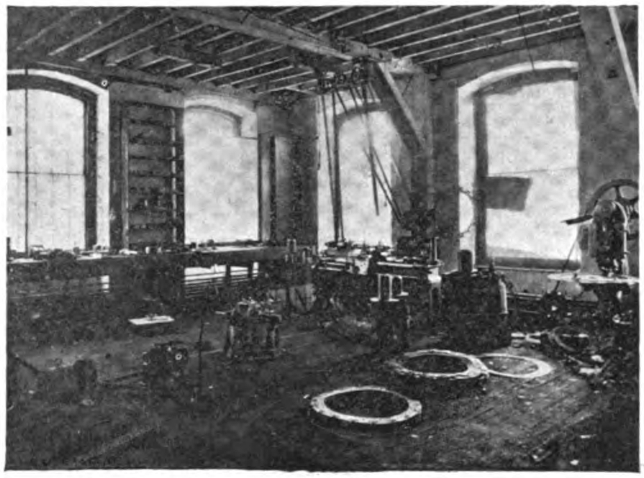
Testing Department.

Although the company have been more recently occupied with alternating machinery, they nevertheless continue to manufacture direct current apparatus, and are now making power generators ranging in sizes from 50 to 300 H. P. All generators of 100 H. P. and under are built on the motor bipolar type. The generators over 100 H. P. are made on the multipolar type with circular fields similar to their alternating machines. The La Roche direct current machine is entirely automatic, the method of regulation being new and different from the ordinary method of compounding. All the direct current machines have Gramme ring armatures, and the company from the very beginning designed machines with armatures greater in diameter than in length. It is evident that this construction admits of a machine of the same output being run at a much lower speed than when the armature is reduced in diameter and increased in length.

A Corner of the Stock Room.

IV.

On the third floor is the brass finishing room which is also well equipped with modern machinery. On this floor also is the armature and field winding department, where the armatures and fields of both direct and alternating apparatus are separately wound on frames or spools and slipped on the machines when completed. In this room there are smooth and toothed armatures in course of construction. In the usual method employed with both the fields and armatures, winding is begun at one end of the wire and carried out continuously, the other end being finally made to cross the convolutions in order to be brought out parallel with the other end; this subjects the crossing end to the maximum difference of potential on the entire coil and is a frequent cause of burn-outs and short circuits due to the inevitable vibration, and consequent damage to insulation, which takes place. In the method pursued by Mr. La Roche, the winding is begun in the middle of the wire, both ends being wound at the same time, and when the wire is finished, the two ends come out opposite each other at the centre of the coil without crossing any other convolution. This method brings the least insulation strain on the wire and the breaking or burning of one end does not require the entire re-winding of the coil.

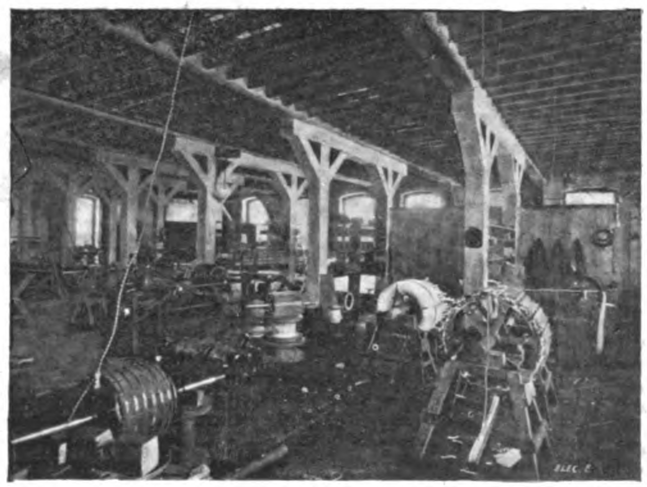


Stamping Department.

Recognizing the value of accurate and reliable indicating instruments in isolated as well as central station work, the La Roche company, almost from the beginning have built the indicating instruments with which their plants have been equipped. These consist of a voltmeter, potential indicator, ammeter-indicator and amperemeter. They are handsomely gotten up, enclosed in brass cases, having either back or surface connections, and lend a very neat appearance to the switchboard.

The fifth floor is used for a wood-working, pattern making and packing room, and the sixth is used for storage purposes. All the floors are connected by an elevator run by an electric motor.

The La Roche company have been running their works for the past six months day and night, working on large alternating machines, and have recently installed several 2,600 light machines and quite a number of 1,300 light alternators. Two of the latter

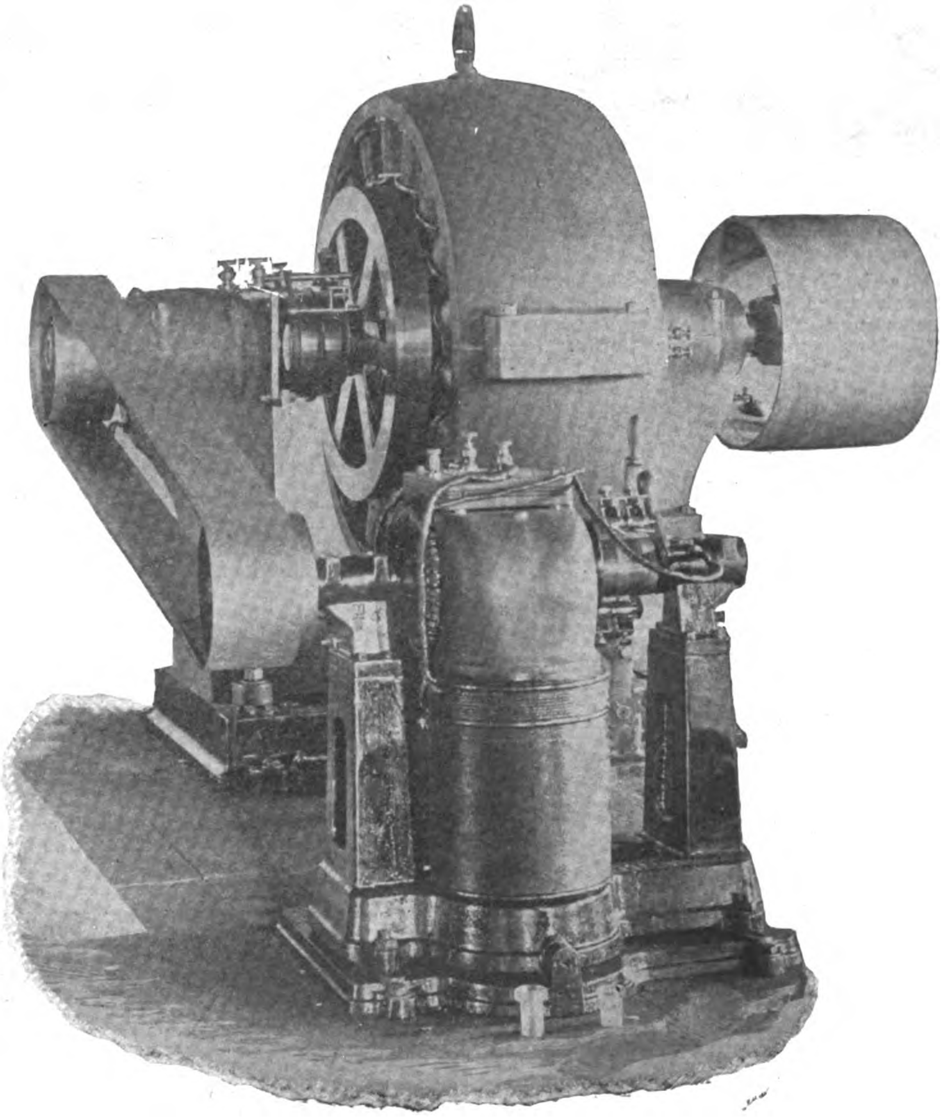


Armature Winding Department.

are now in the station of the Quincy Electric Light and Power Co., Quincy, Mass.

V.

The origin and history of a firm are frequently as interesting and instructive as the description of its products, and this is pre-eminently so in the case of the La Roche company. The moving spirit in the enterprise, Mr. F. A. La Roche, is a type of those who by dint of hard work and studious application compel success in spite of the heaviest odds. Born in 1859, Mr. La Roche at an early age exhibited an aptitude for mechanics that found an application in the building of small steam engines, mechanical toys, etc. At fourteen Mr. La Roche commenced a course of chemistry with Prof. Mathew, in New York, and three years later he removed to Philadelphia and finished a course of civil and electrical engineering under Prof. Beck.



THE LA ROCHE ALTERNATOR WITH EXCITER.

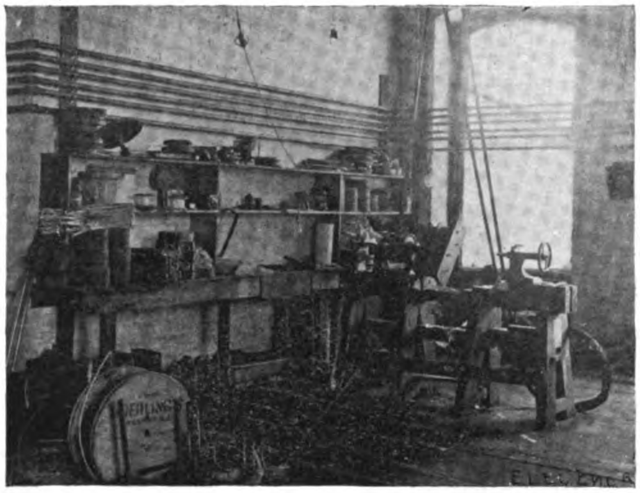
A recital of many of his boyish ideas and experiments would afford considerable amusement, but through them all would be seen that native genius which leads to success. One project in particular on which his youthful dreams of fortune were wrecked, centred in an attempt to build a motor with permanent magnets in which he used the current of several primary batteries to temporarily invert the poles of the magnets by sending around them a current opposed to their natural polarity. The experiment was a failure from an electrical point of view; nevertheless from each such failure he gleaned some valuable information that was stored for future use. Another effort that met with a fate similar to the last, was to combine the storage and gas batteries in the same cell. Mr. La Roche made an iron vessel with a tight-fitting lid and provided the interior of the cell with the elements and compartments for the gases evolved during charging. This battery actually gave three volts before it exploded and this was the consoling thought that repaid him for the disaster. The battery has already been illustrated in the ENGINEER.

Mr. La Roche's experience in the electrical business began about fourteen years ago, when he commenced making laboratory apparatus and afterwards constant current motors. He claims, indeed, to be the first to make a successful automatic cut-off, constant current motor. When Mr. Maxim came to this country and started to manufacture in Philadelphia what was known as the Maxim machine, Mr. La Roche, who was quite young at that time, brought a motor to him and asked him to test it on his circuit. Mr. Maxim answered that no motor could be made that would stand the pressure. He finally put it on the circuit but it heated to a considerable extent, though, after rewinding it was found to work nicely. From that time on Mr. La Roche made a specialty of building both constant current and constant potential motors and up to the present time there are several La Roche constant current motors on the Brush circuit in Philadelphia.

The La Roche Electric Works proper were started in a room 8 x 8 feet, with a small foot lathe and one mechanic,—Mr. La Roche himself. Business seemed to prosper with his small but earnest efforts and an addition was made in the shape of a boy. Business increasing with a strong demand for small dynamos, the whole of the second floor was then taken and about one year afterwards the third floor of the same building. Still finding it necessary to have more room, the building No. 116 N. Sixth street was rented and three floors used, and a short time after that the entire building was occupied. The business still continued to grow, new machinery was purchased from time to time and more men put on, until finally, that building also became too small for the demands and the one adjoining, No. 118, was rented and doors cut through and the company continued there for nearly three years.

The increasing operations of the concern then determined Mr. La Roche in incorporating the business into a stock company which subsequently purchased the property they now occupy at American and Diamond streets, which has been described above.

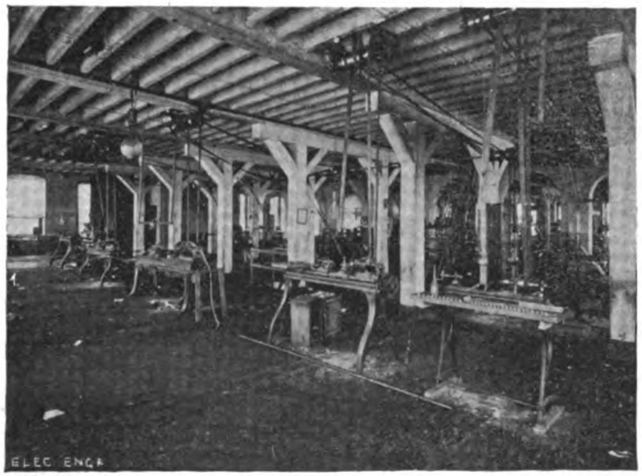
Mr. La Roche has for several years given special attention to alternating current machinery. The excellent alternating system of the company is the result of his labors, as likewise some five or six other systems that are now owned and operated by the company. The determined manner in which he takes hold of a problem generally insures its satisfactory solution. Nothing seems to daunt him, from the requirements of the most delicate instrument work to the building of a 10,000 light dynamo, and these, with everything between them as extremes, are manufactured under his direction.



Glimpse of The Field Magnet Winding Department.

VI.

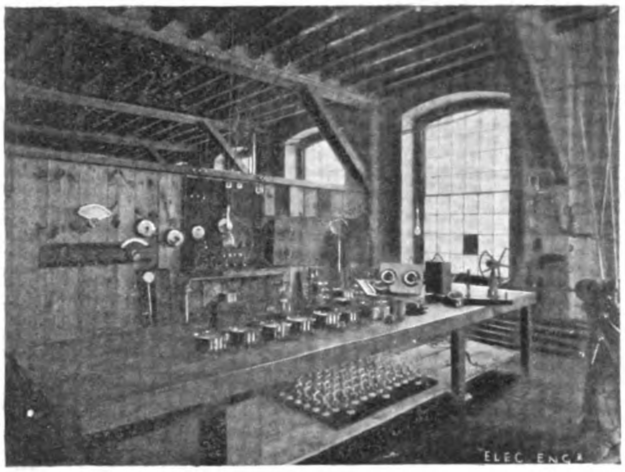
Of late years, Mr. La Roche has surrounded himself with such assistants as the rapidly growing business demanded. Among these is Mr. Frank J. Stevens, the secretary and treasurer of the company who was elected last November to the position he now holds and which he fills to the complete satisfaction of the Officers and Directors. Mr. Stevens is a graduate of the University of Pennsylvania where he took degrees in mechanical and electrical engineering. He was formerly a member of the firm of John S. Stevens & Sons in which he obtained his practical and financial training. His services have proved extremely valuable to the company who feel that they have made a wise selection.



Brass Finishing Department.

Mr. Geo. S. Loutey is the superintendent of construction and installation. He has been in the employ of the company about eight years, is esteemed by the officers for his faithfulness and loyalty, and is regarded as a permanent fixture.

Mr. Wm. G. Toplis, the chemist of the company, has been associated with Mr. La Roche for twelve years. He is known as a first-class chemist and has contributed a number of inventions to the Government.

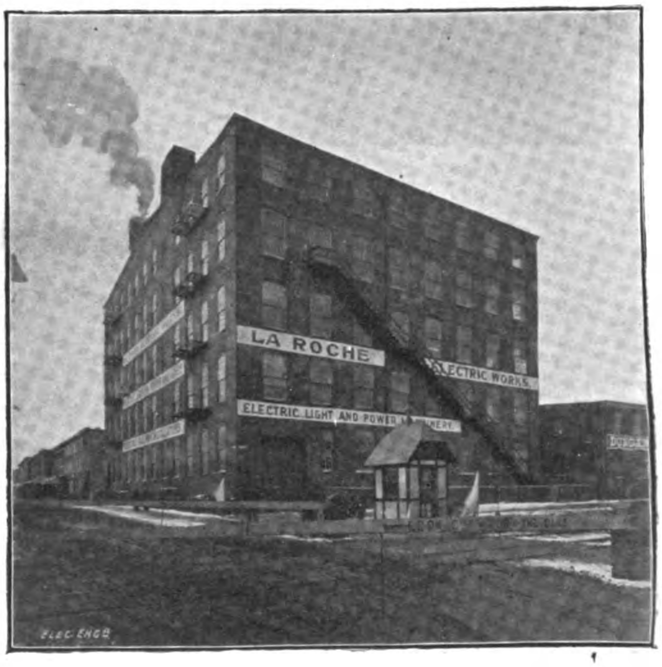


Calibrating and Instrument Department.

Mr. J. W. W. Cornman, a graduate of the Philadelphia Manual Training School has charge of the Instrument Department. He is well versed in the instrument business, having been formerly in the employ of Messrs. Queen & Co.

Mr. Geo. W. Bacon is a member of the engineering staff. He is a graduate of Cornell University having taken degrees in mechanical and electrical engineering and was formerly with the Wightman Motor Co., of Scranton, Pa.

Mr. Frank R. Ford, also a member of the engineering staff is a graduate of the University of Pennsylvania, and was formerly with the Short Electric Co., of Cleveland, O., having had charge of the Chicago office of that company. He now has charge of the railway department of the La Roche Electric Works.



The La Roche Electric Works.

Mr. Gurney F. Coleman who has had an extensive experience in the installation of isolated and central station plants is now associated with the company in that capacity and is well fitted for the position. Mr. Coleman is also a graduate of the University of Pennsylvania.

Mr. C. C. Miller, assistant superintendent of the works, was formerly with the Novelty Electric Co. He attends to the details of the manufacture of the apparatus under the direction of Mr. La Roche.

VII.

Besides its own competent home staff the company have secured the services of a number of able coadjutors in their agencies established in every section of the country. Thus, in New York their interests are well cared for by Mr. W. A. Vail. Mr. Vail began in the electrical field in 1879, with the Bell Telephone Company, of Maine. In the Spring of 1881 he took charge of the uptown construction of the Metropolitan Telephone & Telegraph Company, of New York, and filled nearly every intermediate position until 1887, when he was made general superintendant of that company. In 1880 he resigned to take the position of vice president and general manager of the Boston Heating Company, and remained there until the company wound up their affairs. In February, 1891, Mr. Vail began business as a dealer in electrical supplies which he carried on successfully. On January 15, 1894, he accepted the agency of the La Roche Electrical Works of Philadelphia for New York and New Jersey, with offices in the Electrical Exchange Building, No. 186 Liberty street, New York.

The La Roche Company also have an office in Chicago at No. 239 La Salle street, managed by Messrs. Hood & Osburn. Mr. Owen Ford represents their interests in St. Louis, Mo., Rialto Building; the Southern Brass & Iron Co., in Knoxville, Tenn.; the San Francisco Electric Co., in San Francisco, Cal.; and the Campbell Electrical Supply Co., in Boston, Mass.

F. A. La Roche.

F. R. Ford.

F. J. Stevens.

W. A. Vail.

REPRESENTATIVE MEMBERS OF THE STAFF; LA ROCHE ELECTRIC WORKS.

STEALING CURRENT IN NEW YORK.

Two men were arraigned recently in a New York court for stealing electric power, the case being the first of its kind in the city. Edward Gardner and his brother-in-law had charge of the exhibit of the Roulette Cycle Company of Coventry, Eng., at Madison Square Garden. Frank Martin, the electrician of the garden, observed that the wheels of a bicyle hanging above Gardner's booth were being turned at a rapid rate by some unseen power. On investigation he found that the electric light wires had been tapped, and were connected with a small electric motor, which kept the wheels in motion.

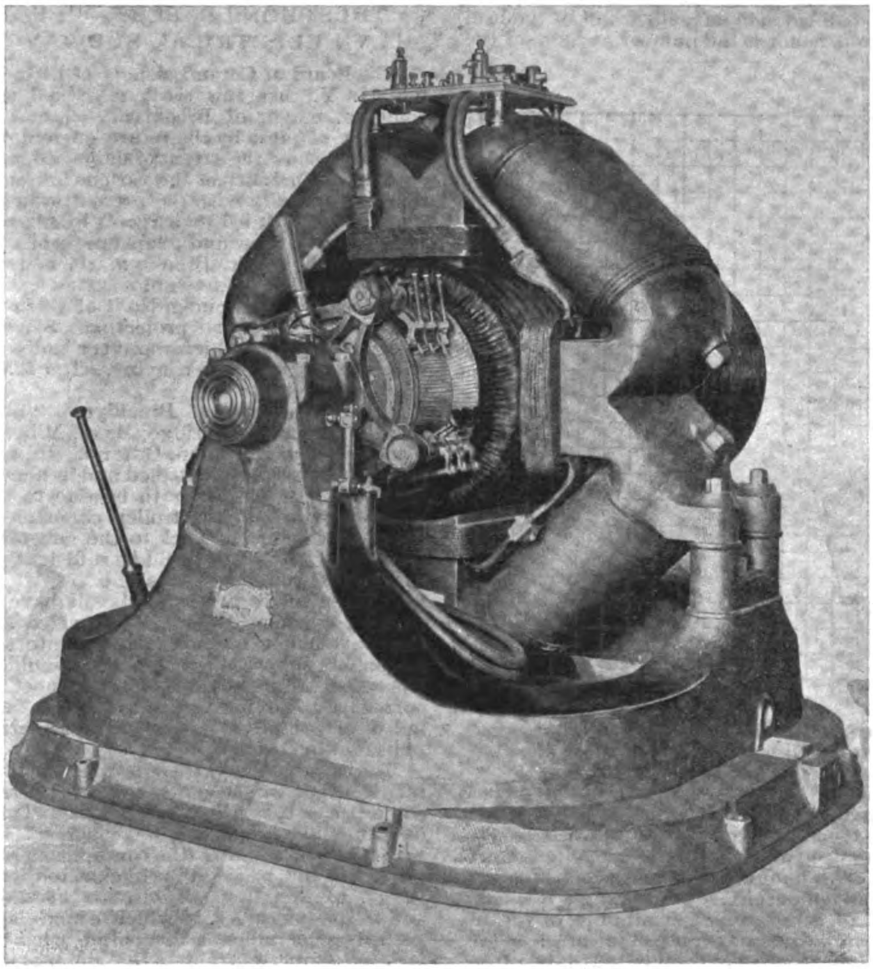
MR. W. A. GILES who for the past three years has carried on the business of mechanical engineering and equipment of steam plants, at Pittsburgh, Pa., has removed to New York where he is representing the Goubert Mfg. Co., at 32 Cortlandt street.

THE "STANDARD" MULTIPOLAR GENERATOR.

The very gratifying success which has attended the introduction of the arc light dynamo made by the Standard Electric Co., Chicago, led the company to believe that the principles involved in the construction of that machine might be successfully applied to the manufacture of other forms of generators, and working from this standpoint they devoted about a year to designing and perfecting a complete line of direct current as well as alternating current apparatus, including all the usual accessories, such as instruments, switches, transformers, etc.

We are enabled this week through the courtesy of Mr. C. E. Woods their electrical engineer, to give our readers an illustration and a brief description of their latest type of multipolar, direct current generator.

The machine is of a solid and substantial design, with large base insuring rigidity and freedom from vibration. The field has four consequent poles, the wrought iron cores being bolted between soft cast iron pole pieces. The two horizontal pole pieces have two lugs each and by them the field magnet frame is bolted to the base, a zinc distance piece being interposed at each side to prevent magnetic leakage to the bed plate.



THE "STANDARD" MULTIPOLAR GENERATOR.

The journal seats are bored in line with the armature bore, and the journal supports being turned in a lathe to a corresponding arc absolute alignment of the shaft with centre of field bore is assured. The journals are self-oiling, two loose rings being provided for carrying the oil from a reservoir to the shaft. The journals are self adjusting, being of the universal ball bearing type, allowing the armature shaft to have all necessary adjustment at all times. By removing a pedestal at either side of the machine the armature can be easily and quickly taken out for inspection or cleaning.

The armature is of the conventional Gramme ring type, but has several important modifications in its details, securing better insulation and absolute stability of the armature conductors. The soft iron armature rings are supported by a split gun metal spider.

The commutator shows several important improvements in its construction, no insulation except air being used between the segments, where the brushes come in contact with the commutator bars. The mechanical construction of the commutator is such as to enable any intelligent mechanic to renew any defective segments or even replace the entire commutator in a comparatively short time.

A neat and substantial switchboard of slate or marble is supported over the two upper fields and incidentally quite an ingenious use is made of the well known property of a magnet to repel an arc. The two main line fuses are located almost directly over the ends of the upper fields and the result is that in case a fuse is blown from any cause, all dangerous arcing is prevented, owing to the repelling action of the pole piece underneath the switchboard.

The brush holders are of a novel and neat design, short blocks of carbon being clamped firmly between two metal jaws, thereby giving a minimum resistance to the brush proper and securing perfect contact with the commutator. In the 125 H. P. machine, five brushes, each 1¼ inches wide, are used on each brush holder stud, the current allowed in the commutator being as low as 200 amperes per square inch. The two sets of brushes of the same polarity are connected together by two double connecting bars, no cross connections in the armature itself being used.

The base is arranged so that a pawl and ratchet may be applied to either end, and in case it is desired to reverse the direction of rotation of the armature, no change in the connections is required, the simple reversing of the brushes and bringing them into the opposite neutral plane, respectively, being all that is necessary.

The more important data of a 100 K. W. 110 volt machine are as follows :

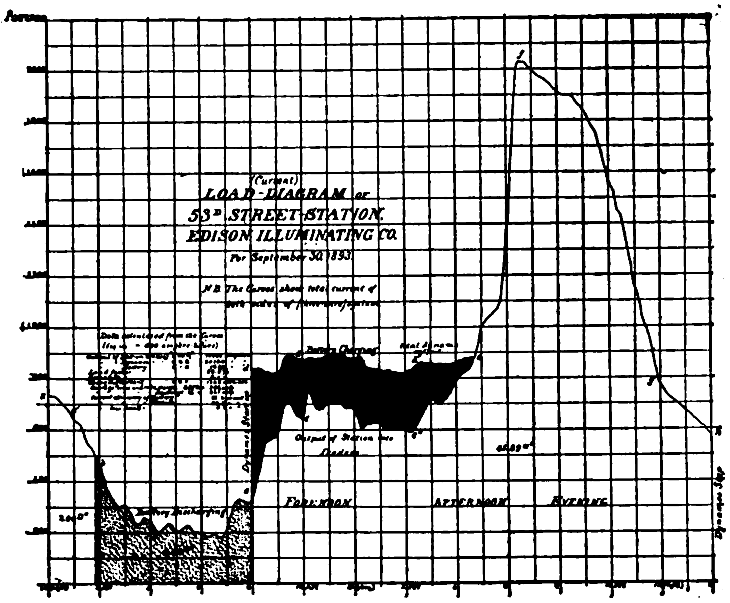
Output	100 K. W.
Speed	425 rev. p. min.
Diameter of armature, over all	29 inches
Length " " " "	18.5 "
Diameter of commutator	18 "
Number of segments in commutator	144
Magnetism in pole pieces per square inch (B)	46,000
" " armature per square inch (B)	60,000
Current density in armature conductors	2,000 amp. per sq. in.
Resistance of field coils	18 ohms.
Shipping weight	14,000 lbs.

The Standard Electric Company will soon have a complete line of these machines on the market of 110, 220 or 500 volts. Several of the machines are already in use in Chicago and giving the best of satisfaction.

STORAGE BATTERIES FOR CENTRAL STATIONS, POWER PLANTS AND LARGE ISOLATED INSTALLATIONS.

The Consolidated Electric Storage Battery Company, of Philadelphia have recently issued a pamphlet, No. 8 of its series, from which may be gathered some highly interesting data on storage battery practice. Whatever differences of opinion may exist as to the universal use of storage batteries in electrical industries, their advantages as an auxiliary in isolated and central station lighting and in power stations are universally conceded. These advantages have been very largely embraced in Europe, where we find something over 175 central and sub-stations equipped with storage batteries, and a much larger number of isolated plants; while in this country there are but two central stations equipped with storage batteries and less than one hundred isolated plants. The monthly sales of storage batteries of one factory in in Germany amount to $125,000; an English storage battery company approximates this figure, and Paris with its thirty storage battery central and sub-stations, creates a considerable demand.

The first requisite in determining whether a battery can be advantageously introduced in any given central station, and if so what its size or capacity shall be, is to have diagrams of the load curves. The next important factor is the number and size of the units employed at the station. From this data may be determined the load factor, and then it is easy to calculate the size of the battery required to give the most economical operating results. Once the size of the battery determined, we can calculate the saving effected by dispensing with a night shift; by diminishing the consumption of coal for a given output; by operating a few large units of one size, instead of a number of small units of various sizes; by operating each unit at its maximum efficiency; and by the additional revenues from increase of total output taken from the battery at the time of maximum load.



LOAD DIAGRAM OF 53D STREET, EDISON STORAGE BATTERY STATION, NEW YORK.

As the item of labor in small stations is frequently as high as twenty-five per cent. of the operating expenses the saving effected by dispensing with a night shift is not inconsiderable. By operating exclusively large units there is also a material saving effected both in labor and the much heavier efficiencies of large over small units. Again, as the coal bill is one of the largest items of expense, amounting in some cases to fifty per cent. and over of the total operating expenses, any saving effected in this item is of paramount importance, and is reflected at once in the decrease in operating expenses.

The question of mechanical efficiency with varying loads has not been as carefully studied with each type of engine as its importance deserves, but Prof. W. Cawthorne Unwin, F. R. S., has shown that the decrease of mechanical efficiency for light loads has a serious effect on the economy of working with a variable load and that with a load varying from one hundred to twenty-five per cent., the efficiency decreases from eighty-five to forty per cent.

While it is impossible to say in a general way what the exact saving would be from the introduction of a battery of sufficient size to permit of the operation of all the units at maximum load (since the load is not the same in any two stations), the results prove that in central stations equipped with storage batteries the operating expenses are diminished as much as thirty per cent.

In addition to the saving effected in operating expenses the use of a battery may be made to yield additional revenues in proportion to the amount of current supplied to the circuit over and above what could be supplied by the direct system, at the time of maximum load, except by increasing the size of the power plant. Central station lighting is one of the most important fields of usefulness of the storage battery and one which has hardly yet been touched upon in this country. The same arguments apply with increased force to its application in a power house for electric traction. Here the variation in the load is between such wide limits and of such a sudden character as to render it impossible to operate the power plant on anything like an economical basis.

In all such cases by the introduction of a sufficiently large battery the load curve, instead of resembling a stroke of lightning as it does at present, could be perfectly equalized, as shown in the accompanying diagram, enabling the power plant to operate at full load and maximum efficiency.

CORROSION OF WATER PIPES, GAS PIPES AND TELEPHONE CABLES.—REPORT OF THE BROOKLYN ELECTRICAL SUBWAY COMMISSIONERS.

The Board of Commissioners of Electrical Subways of Brooklyn, N. Y., has this week presented to the Hon. Charles A. Schieren, mayor of Brooklyn, a special report on the subject of corrosion of pipes by the return current of the street railway systems. To show the extent of damage done to gas and water pipes, etc., by the inability of the various lines to control the return current of electricity with the present system in vogue, the commissioners accompanied their report by nine different photographs of specimens of pipe and telephone cables removed by them from various localities in Brooklyn. It had been claimed by various electricians that pitch would act as an insulator in covering telephone cables. Specimen No. 1 of this report shows conclusively that pitch proved no protection. Specimen No. 8 illustrates a piece of iron pipe which was very badly corroded and perforated within thirty days after laying. The following is an abstract of the special report:

"The experience of Brooklyn is not notably different from that of Boston, Cambridge, Mass., Milwaukee, Columbus, O., Indianapolis and Hamilton, Ontario. In each of these cities similar corrosions have been detected and in none is there any doubt as to the cause. It is known to be due to the imperfections of the means provided by the trolley companies for the conveyance of the electrical current back to the generator. It was at first supposed that the rails would be sufficient, but the current declines to take that route exclusively.

"The remedy of the evil will have been applied when the trolley companies shall have provided an adequate route for the electric current now discharged into the rails. It was at first reasonably supposed that the rails would afford a sufficient path. Upon the failure of this plan, a copper connection, to carry the current by the joint, was tried. In most cases this expedient failed of complete success, except when the copper bond had unusual dimensions."

The commissioners then devote about two and one-half pages of their report to an account of some experiments relating to proper connections between the rails, taken from THE ELECTRICAL ENGINEER, and with which the readers of this journal are already familiar. Continuing, the commissioners say:

"It should be said in reference to this second method (merely the connection by metal circuits of the water mains, gas pipes and telephone cables, to which some electricity will always pass, with the generators at the points where there is the least resistance to return currents), that in making connections with the underground systems of pipes and cables, the points of such connections would require frequent examination. A copper connection with an iron pipe underground would not long remain a reliable conductor, unless special care and watchfulness are given to it.

"A better way to insure the conduction of the current is doubtless to make the car rail continuous by welding. This method will be employed on the new trolley line soon to be built in the southern part of the city.

"The most complete solution of the problem is afforded by the double trolley by which the return current is provided for by an overhead wire similar to the one for outgoing current. But it is to be hoped that it will not be necessary to resort to this method."

Some notes of experiments obtained through the kindness of Mr. I. H. Farnham, Electrician of the New England Telephone Co., and relating to the early experience in Boston, are here given.

When the action of the current was first noticed, the experiment of grounding the cable to lead plates buried in manholes, was tried on quite an extensive scale, but was soon abandoned as being impracticable. The quantity of electricity to be dealt with was so enormous that the buried plates offered no appreciable protection to the cables. If such a system were feasible, the expense for the constant renewal of plates would be very large.

The severity of the action to a certain limited extent, was reduced by so arranging the direction of the current used for the street railways, as to make it pass out over the trolley wires, and back through the ground. In this way the direction of the current would be quite generally from the earth to the cables, thus diminishing in certain places, the corrosive action. This method would not be a complete protection from the corrosive action, as there would be places where the current would still flow from the cables. Even though the current is uniformly to the earth from the cables, there is the possibility of an action caused by alkaline substances formed about a cable, due to decomposition by the current from the street cars of the soluble salts contained in the surrounding earth. There alkaline substances are capable, under certain conditions of dissolving the lead, when the currents are shut off or much reduced, as would be the case at night.

As there has been some misunderstanding in regard to the potential measurements made in connection with the numerous corrosion investigations, it should, perhaps, be impressed upon those who are about to carry on similar investigations, that the potential measurements between the cables or pipes and the material surrounding them, should, in the majority of cases, only be looked upon as incating the direction in which the current tends to flow.

To say that the pipes and cables are even practically safe from corrosion when the measurements are below a specified figure, would be extremely misleading. The measurements are, in a certain sense, like the measurements which might be made in an electrolytic cell, between one of the electrodes and various portions of the electrolyte, so that it is possible to conceive of almost zero potentials in the immediate vicinity of the most violent electrolytic corrosive actions.

The fact should be closely borne in mind that whenever we have a current passing from an easily oxidizable metal to the liquid, such as would be encountered in the earth, corrosion is bound to occur.

A large number of electrolytic experiments have been carried out, showing the extremely low potentials (measurements between the electrodes) at which corrosion is found to take place. In many cases iron and lead were destroped, under the conditions encountered in the underground systems, at potentials considerably under .5 volt.

"The conclusions fairly drawn from these notes and from our own experience is that considerable injury is being done to underground pipes and cables, and that it will continue along the lines of the trolley roads (except where the elevated railway extends above them) until better methods of returning the current to the generator are put in practice. The electricians of the several trolley roads are fully aware of the situation and have speedily applied means of prevention in localities where the corrosion had been detected. But it is doubtful if the method of final cure of the difficulty has yet passed the experimental stage." The report is signed by Prof. Geo. W. Plympton and Fred R. Lee, commissioners.

PERSONAL.

Mr. John J. Moore, formerly general manager of the East River Electric Light Co., in New York and identified with numerous undertakings of the General Electric Co. in the past, has been appointed general manager of the Narragansett Electric Light Co., of Providence, R. I. Mr. Marsden J. Perry, the vice-president of the company remains in control as heretofore.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the Meeting of the Institute, held Wednesday, Feb. 21, the two following papers were read: "How Shall We Operate an Electric Railway, 100 Miles from the Power Station," by H. Ward Leonard; and "Concerning a Change of Policy in the Administration of the Patent Office," by Philip Mauro.

The Report of the Committee on Revision of Election Rule was presented, but action on the adoption of the rule was deferred so as to permit the question to be decided by the Annual Meeting.

The following gentlemen were transferred from associate to full membership:—Byron C. Wolverton, Elmira, N. Y.; C. Reginald Van Trump, Wilmington, Del.; Wm. D. Sargent, Brooklyn, N. Y.; Clarence E. Gifford, Buffalo, N. Y.; Jesse R. Lovejoy, Boston, Mass.

The following were elected to associate membership:—Clifford D. Babcock, New York City; William S. Barstow, Brooklyn, N. Y.; Albert L. Clough, Manchester, N. H.; James W. Crosby, New York City; George Forbes, London, England; Arthur Frantzen, Chicago, Ill.; Edward M. Gerry, Newark, N. J.; Charles Gesseaume, Newark, N. J.; Harold Harrison, Montclair, N. J.; E. Randolph Hix, New York City; James A. Lighthite, San Francisco, Cal.; H. H. Morehouse, Quezaltenango, Guatemala, C. A.; Chas. Edwin Potts, Brooklyn, N. Y.; Albert E. Richardson, London, Eng.; Chas. F. Rittenhouse, New York City; S. D. Snook, Brooklyn, N. Y.; E. W. Trafford, Richmond, Va.; Augustus Treadwell, Jr., Brooklyn, N. Y.; George E. Wendle, Bethlehem, Pa.

LETTERS TO THE EDITOR.

PAYING STATIONS.

In your issue of the Feb. 14, you refer to the paper read by the writer at the recent meeting of the Northwestern Electrical Association, and claim that my assertion that it is the direct current stations which are paying the dividends is founded merely upon "belief" and not on fact, and further, state that dogmatism has no place in science or business.

If you had read the first part of my paper (which you failed to publish), you would have seen that I clearly stated the advantages of the alternating system for certain work, confining my advocacy of the direct current system to average towns of 30,000 inhabitants or less.

To show how far my arguments were founded on fact, I beg to submit the following statement as to the condition of the electric lighting industry in the State of Wisconsin, where the paper was read:

In Wisconsin there is not a single alternating current central which is paying a satisfactory dividend on the money invested, with possibly two exceptions. In the same State nearly every direct current station is paying handsomely, some as high as 17 per cent. per annum.

A distinguished electrical engineer and member of the jury at the World's Fair, stated at a former meeting of the Northwestern Association that he had tested alternating stations in which 60 per cent. of the current is lost to the company; a similar experience is not uncommon to other members of the profession. This is not an argument *per se* against the alternating system, but goes far to prove that the average country electrician cannot get the best results out of his apparatus.

The stock, and almost only, argument against the direct current system has been the high cost of copper; at present prices for that metal, this argument has lost its force. A five-wire system is now cheaper in 90 per cent. of the estimates made than the alternating.

For an example of pure "dogmatism" in electrical matters, I would refer you to the February number of the *Engineering Magazine*, an article in which states that the direct current system is totally out of the question for small towns! This author sees me and goes one better with a vengeance.

W. N. Stewart.

Chicago, Feb. 20, 1894.

STORAGE BATTERY LITIGATION.

I notice in your last issue a communication from Mr. W. W. Gibbs, President of the Electric Storage Battery Co., in which, after serving up the old story of Profs. Chandler and Barker as to the chloride accumulator not being an infringement of the Brush patents, he goes out of his way, in tradesmanlike style, to decry the wares of his rival. He tries to make us believe that this attack is evoked because my Company has seen fit to exercise its legal right to sue him for infringement of our patents. This is the only offence of which we are guilty. We disclaim Mr. Gibbs' charge of the circulation of any objectionable matter in relation to this battery, except that in one or two instances we have sent to purchasers the usual notice of infringement, which, in a measure, we are bound to do, under the rulings of the courts, if we expect to invoke the aid of the law in securing damages hereafter.

I think Mr. Editor, that the over-confidence which Mr. Gibbs assumes is calculated to give all the less weight to his statements. You will perceive that this is the more so when I tell you that the Company owning the chloride battery in France, the "Société Anomyme pour le Travail Electrique des Métaux," was sued last year by the company owning the French Faure patent, and that Baron Rothschild, who is largely interested in the Chloride Battery Co., purchased peace at the expense, as I am informed, of several hundred thousand dollars. The French Faure patent is the equivalent of the American patent No. 252,002, and has only *one year* from next October to run. It was decided by our courts here that the Faure patent and the Brush patent were for the same invention. The same decision was rendered by the Patent Office, in the interference between Brush and Faure. The Faure patent was also sustained by the highest courts in Germany, in a decision much more far-reaching than any of the American decisions sustaining the Brush or Faure patents here.

In the light of these facts, it can hardly be contended that Mr. Gibbs is candid in proclaiming to the public that he does "not infringe the Brush or any other patents in the slightest degree." Profs. Chandler and Barker, under whose banner he hopes to win the coming battle, were also expert witnesses in the attempt to break down the Brush and Faure inventions in former suits, and they swore with as much zeal and vehemence in those former suits that the Brush-Faure patents were invalid, etc. It is fair to presume, in the light of history, that their affidavit which Mr. Gibbs publishes, would hardly justify a man in purchasing the chloride battery, or the public in believing them. The fact is, we must assume that Mr. Gibbs is desperate, for he writes like a desperate man.

WM. BRACKEN,
President, *Consolidated Electric Storage Co.*
NEW YORK, Feb. 23, 1894.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED FEBRUARY 13, 1894.

Alarms and Signals :—

Electrical Signal Apparatus, G. W. Hey, Syracuse, N. Y., 514,461. Filed April 22, 1892.

A signal designed for telephone or telegraph service employing a line conductor and actuating mechanism at each station connected to the line conductor and acting to bring the terminals of the circuit closers at one station into contact with each other and simultaneously returning to their normal position the normally separated terminals of the circuit closers at the other station.

Electrical Signal Apparatus, G. W. Hey, Syracuse, N. Y., 514,462. Filed May 9, 1892.

Similar to No. 514,461.

Electrical Annunciator, C. F. Scattergood, Albany, N. Y., 514,501. Filed Nov. 3, 1893.

An automatic electric target signal.

Electric Railway Crossing Signal, M. J. O'Sullivan, Baltimore, Md., 514,566. Filed May 22, 1893.

Electric Annunciator, I. E. Rickey, Oakland, Cal., 514,686. Filed May 10, 1893.

Relates especially to a resetting device for drop annunciators.

Electric Alarm for Pressure Gauges, W. H. Bradt, Troy, N. Y., 514,697. Filed Nov. 22, 1893.

Electric Alarm, S. T. Sanders, Granite, Montana, 514,775. Filed July 29, 1893.

An alarm for mine elevator shafts.

Conductors, Conduits, and Insulators :—

Electrical Conductor, D. B. Hayward, Easton, Md., 514,460. Filed July 21, 1893.

Claim 2 follows:

An electrical conductor formed of twisted or woven graphite coated asbestos fibre.

Insulating Joint, E. F. Gennert, Brooklyn, N. Y., 514,822. Filed Aug. 10, 1893.

Electric Cable, T. Guilleaume, Cologne, Germany, 514,849. Filed Mch. 27, 1893.

Consists of a crimped cylinder of non-conducting material having helical grooves in which are bare conductors.

Distribution :—

Electrical Transmission of Power, C. S. Bradley, Yonkers, N. Y., 514,586. Filed June 28, 1890.

Employs a continuous current generator, a phasing device electrically connected therewith for converting the current into alternating currents of differential phase, and a motor the field magnet of which is charged by a continuous current and the armature by the alternating currents.

Dynamos and Motors :—

Current Regulator for Dynamo Electric Machines, C. E. Scribner. Chicago, Ill., 514,504. Filed Dec. 10, 1888.

Consists of an electro-magnet included in the main circuit, a low resistance shunt around the electro-magnet, a rod operated by the magnet and controlling the movement of the brushes.

Influence Machine, H. F. Waite, New York, 514,524. Filed Oct. 28, 1893.

Armature Connection for Dynamos, O. Dufault, Spencer, Mass., 514,817. Filed Oct. 27, 1893.

A connector for commutator bars consisting of an L shaped piece of metal furnished with a dowel formed of the end of the lead, and with a projection for retaining the binding cord.

Galvanic and Thermo-Electric Batteries :—

Electric Battery Cell, P. C. Burns, Peru, Ind., 514,845. Filed June 12, 1893.

Claim 1 follows :—

In an electric battery cell, a carbon element having grooves or depressions in which are plugs or pencils of insulating material projecting beyond the surface of the said carbon element.

Lamps and Appurtenances :—

Electric Arc Lamp, C. E. Scribner & E. P. Warner, Chicago, Ill., 514,505. Filed May 27, 1890.

Has for its object to automatically separate the carbons when the current passes and to maintain a uniform arc.

Electric Arc Lamp, C. E. Scribner, Chicago, Ill., 514,506. Filed Aug. 1, 1891.

Has for its object to provide circuits whereby arc lamps may be burned in groups; the members of each group burning separately, one after the other.

Electric Arc Lamp, J. E. Woolverton, New York, 514,583. Filed Sept. 22, 1892.

Claim 1 follows :

In an arc lamp the combination of a pair of converging rods, one at least of which is an arcing electrode, and a corresponding arcing electrode, with means for equalizing the feed of the pair of rods comprising a pair of lazy tongs mechanically connected therewith.

Incandescent Electric Lamp, G. H. W. Timbrell and J. C. Fyfe, Denver, Col., 514,789. Filed Sept. 18, 1891.

Employs a reflecting cylinder within the lamp about which the incandescent filament is helically wound.

Measurement :—

Apparatus for Testing the Resistance of Conductors of Electricity, E. G. Willyoung, Philadelphia, Pa., 514,580. Filed June 26, 1893.

Employs conductors constituting a multiple arc circuit one of whose branches comprises two resistances and means for supporting a test piece in series between them, and the other of whose branches comprises also two resistances ; and means for determining the point at which the potential of the branch containing the test piece is the same as that of the other branch at the junction of its two resistances.

Electrical Measuring Instrument, E. G. Willyoung, Philadelphia, Pa., 514,581. Filed Oct. 13, 1893.

Relates to details in the construction of quadrant electrometers.

Electrical Measuring Instrument, M. M. Garver and E G. Willyoung, Philadelphia, Pa., 514,593. Filed Oct. 18, 1893.

Similar to No. 514,582.

Electrical Measuring Instrument, E. G. Willyoung and M. M. Garver, Philadelphia, Pa., 514,582. Filed Oct. 18, 1893.

A hot wire measuring instrument on the Cardew principle employing a plurality of compensating wires, each substantially identical with the working wire. See page 194 this issue.

Miscellaneous :—

Electrical Firearm, J. L. McCullough, Brooklyn, N. Y., 514,491. Filed Apl. 7, 1893.

Garment Hook, R. Ahlers, Brooklyn, N. Y., 514,584. Filed Dec. 9, 1893.

An electrical hat and coat rack adapted to sound an alarm upon the unauthorized removal of any of its contents.

Electric Pendulum Clock, H. Campiche, Geneva, Switzerland, 514,641. Filed July 28, 1893.

Cigar-Tip Cutter and Lighter, W. E. Duthie, Indianapolis, Ind., 514,647. Filed Dec. 8, 1893.

Electric Cigar Lighter, A. J. Graydon, Indianapolis, Ind., 514,651. Filed March 6, 1893.

Electrolytic Cell, E. A. Le Sueur, Ottawa, Can., 514,681. Filed April 15, 1893.

Apparatus for Periodically Completing and Interrupting Electric Circuits, E. L. Berry and F. Harrison, London, Eng., 514,746. Filed Oct. 6, 1893.

Electric Lock, R. V. Cheatham, Louisville, Ky., 514,813. Filed Feb. 7, 1893.

Railways and Appliances :—

Electric Railway, P. W. Leffler, Minneapolis, Minn., 514,561. Filed May 13, 1893.

Claim 1 follows :

The combination with a car, or other traveling body, of field magnets in the line of travel, a non-rotating armature on the car, electric connections for the field and armature magnets, and an automatic rotary pole changer carried by the car, located in the connections to the armature magnets and operated by the field magnets.

Bond Wire for Electric Conductors, A. Hoffman & J. Brogan. Milwaukee, Wis., 514,714. Filed July 5, 1893.

Electric Railway System, P. W. Leffler, Minneapolis, Minn., 514,718. Filed Nov. 22, 1892.

Similar to No. 514,561.

Trolley, J. A. Williams, Altoona, Pa., 514,801. Filed Oct. 7, 1893.

Employs removable shaft blocks.

Electric Railway Conduit, R. I. Hampton, Athens, Ga., 514,837. Filed May 25, 1893.

Claim 7 follows :

An electric conduit, composed of a trolley rail chamber, a drain-way below the trolley rail chamber, and a cable-way located at the side of the trolley rail and provided with removable rack bars superimposed transversely in the cable-way to support and hold apart the cables.

Electrically Operated Street Indicator for Cars, H. C. Barker, St. Louis, Mo., 514,878. Filed June 28, 1893.

Switches and Cut-Outs :—

Cut-Out, H. Lemp, Lynn, Mass., 514,480. Filed Oct. 5, 1888.

Provides means whereby a lamp may be automatically substituted for one that has gone out where the lamps are arranged in series.

Telephones and Apparatus :—

Telephone, C. T. Bloomer, New York, 514,695. Filed May 9, 1893.

Claim 1 follows :—

In a transmitter, the combination of a diaphragm, a conducting fluid included in the circuit of the transmitter, a flexed flexible strip mechanically connected at one end with the diaphragm, suitably supported at its other end and immersed in said fluid.

Telephone Signaling System, W. Gillette, New York, 514,823. Filed July 13, 1893.

Employs a main circuit for holding the alarm out of action, a local circuit for the alarm, a circuit breaker for disconnecting the main circuit from the alarm and leaving the local circuit free to actuate the alarm.

NALDER BROS. & CO., OF LONDON.

We have received the following notification from the firm of Nalder Bros. & Co., London, electrical engineers and manufacturers of electrical and scientific instruments :—

> Owing to the numerous inquiries we have had recently as to whether we have changed the constitution and address of our firm, we feel it incumbent on us to state that there has been no change whatever, and that the partners F. H. Nalder, H. Nalder, C. W. S. Crawley and A. Soames, who have conducted the business during the last six years, still carry it on as Nalder Bros. & Co., and that our sole place of business is at 16 Red Lion Street, Clerkenwell, London, E. C. as heretofore.

WAKEFIELD ELECTRICAL ENGINEERING CO.

THE above company, Room 781 Reading Terminal, Philadelphia, Pa., have secured the contract for a seven mile extension of the Lehigh Traction Co., Hazelton, Pa. The work will be in the charge of Mr. A. W. Gilbert, the constructing engineer for the Wakefield Co. The road is to be built in a very substantial manner, and graded according to steam road practice. It will include several large trestles.

MONTCLAIR, N. J.—Application for an incandescent street and commercial lighting franchise was made to the Township Committee of Montclair. N. J., on February 19, by Paul Wilcox and other local capitalists. From 500 to 800 incandescent lamps would be required, according to street milage and candle power. Mr. M. N. Baker is chairman of the Street Lighting Committee.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

CROCKER-WHEELER STANDARD MULTIPOLAR MACHINES.

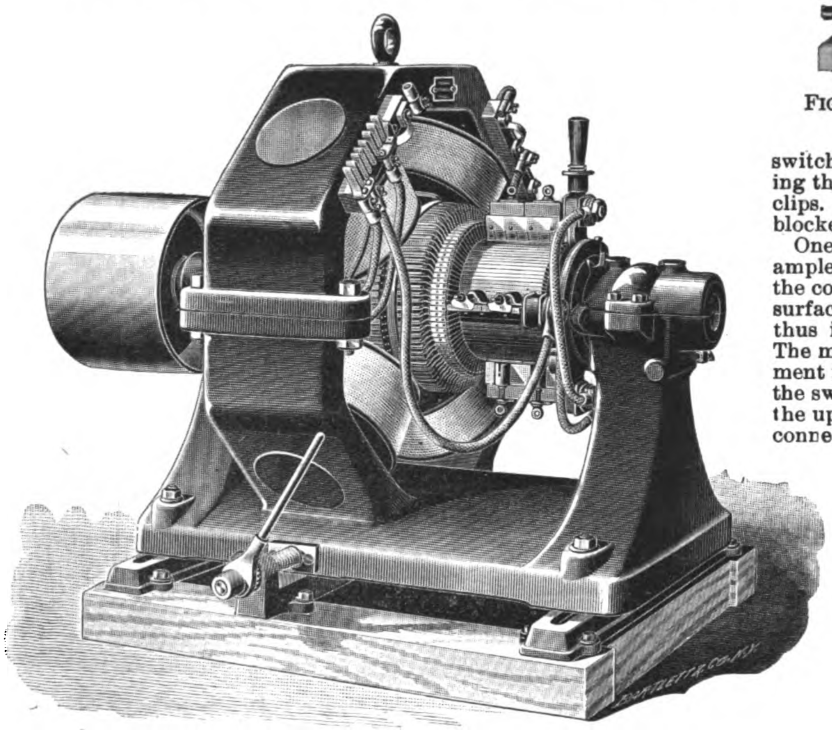
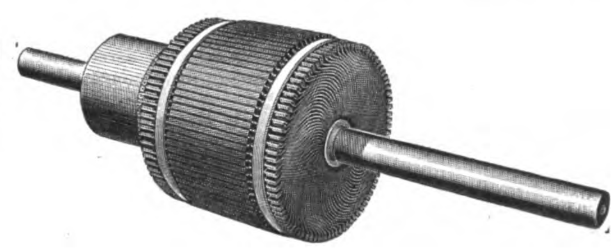
Since moving to their new works at Ampere, N. J., the Crocker-Wheeler Company have been very busy perfecting a line of larger sizes of dynamos and motors, of the type illustrated in the accompanying engraving, Fig. 1. The detail of these motors and dynamos represents the work of their entire engineering staff during the past year. As will be readily seen, care has been taken to produce an artistic design, a solidity of construction, and a close adjustment of proportions electrically within the machine.

In the multipolar type illustrated, the steel magnets are turned to gauge and set into the yoke, the outer end of the holes for the fields being covered by a thin circular plate. The pillow block standards are cast in one piece with the base; the armature is accessible by removing the caps of the bearings and the upper half of the magnet frame, thus admitting of the armature's being lifted vertically out of the bearings when the upper half of the magnet frame is thus removed. The rocker arm is made in halves, held together by wing nuts, and travels upon a grooved ring attached to the pillow block standard and slotted, the grooved ring being cut away through the upper side, wide enough to permit the shaft to be lifted out. No solder is used in any part of these machines, and besides being built to stand 25 per cent. overload without undue heating, they will stand an altogether unusual degree of heating without injury.

The multipolar types above 25 H. P. (20 K. W.) for 110 volts, have armature conductors of rectangular copper bars riveted together by means of strip copper end connectors in place of the ordinary wire windings, as shown in Fig. 2. The armatures thus "wound" although for multipolar machines, have but two circuits and may therefore be operated with one set of brushes instead of two sets, because of the novel cross-connections with the armature. The common practice in multipolar armature winding heretofore employed, renders one portion of the armature liable to short circuit the other portions if there is any inequality in the strength of the fields. This construction is an improved form of that formally built by the Standard Electric Company, of St. Johnsbury, Vermont, of whom the Crocker-Wheeler Company are the successors in this line. This form of armature is the invention of Mr. C. S. Bradley, and was the prototype of the bar wound armatures now commonly made in large sizes, such as for railway generators, etc.

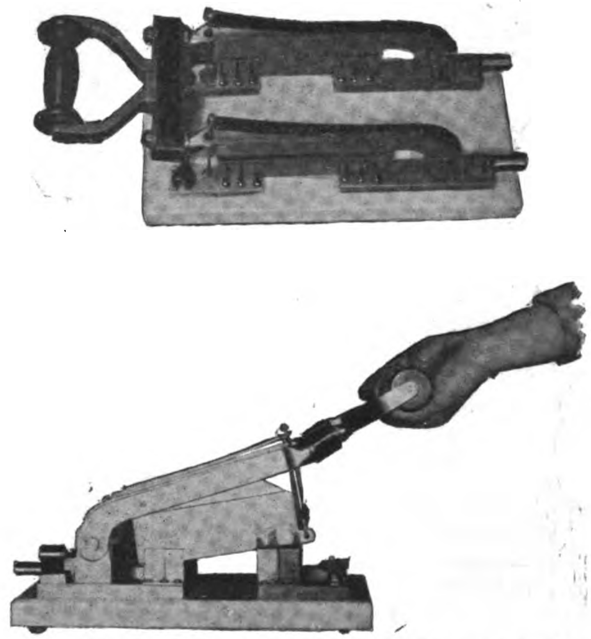
The new standard machines being brought out by the Crocker-Wheeler Company are, as a matter of course, of high efficiency, but what is more important is the fact that the necessary losses are evenly distributed in the various parts of the machine, so that the heat produced by these losses may be evenly distributed, and thus permit the machines to stand the greatest abuse without any one part suffering in excess. This point of distribution of the efficiency losses seems to be the direction in which to look for improvement, and is a matter about which engineers of the company are very wide awake.

For the equipment of the modern industrial power plants this higher class of apparatus is particularly adapted. One plant furnished by the Crocker-Wheeler Company already amounts to about 500 H. P. in motors alone, to which large additions are being frequently made.



FIGS. 1 AND 2.—THE CROCKER-WHEELER STANDARD MULTIPOLAR MACHINE AND ARMATURE.

CENTRAL ELECTRIC NEW MAIN LINE SWITCH.

One of the latest productions of the Central Electric Co., Chicago, is their double pole, main line station switch, illustrated in the accompanying engravings. It has several points of merit, well worthy the attention of those interested. Fig. 1 shows the switch closed and Fig. 2 shows the switch at the moment of breaking the circuit, the blades just being at the point of leaving the clips. For the purpose of illustration, the blades have been blocked, showing the "quick break" springs under tension.

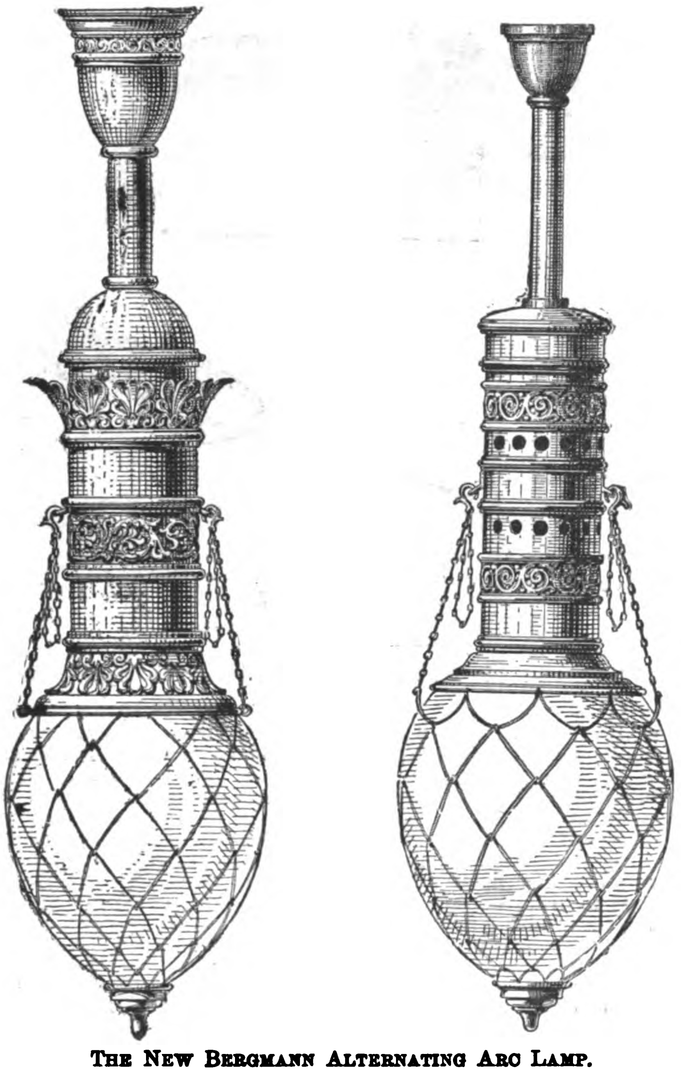

FIGS. 1 AND 2.—THE CENTRAL ELECTRIC NEW MAIN LINE SWITCH.

One of the most important points in a circuit breaking device is ample carrying capacity. This has been provided for by making the contact clips and blades relatively large, giving great contact surface. The blades are hung loosely in their supporting bars, thus insuring perfect alignment of the tongues with the clips. The most salient feature of the switch, however, is the arrangement for securing a quick break, independent of the movement of the switch-arm or handle. As clearly shown in the engravings, the upper side of each switch arm carries a stiff, flat steel spring, connected by a small rod to the lower edge of each blade. The friction between the contact clips and blades is sufficient to put the spring under tension whenever the blades are withdrawn from the clips. As soon, however, as the blades are about to leave the clips, the force of the springs asserts itself, causing the blades to be suddenly withdrawn a sufficient distance to prevent arcing.

Incidentally, the peculiar arrangement of the springs secures another important advantage, consisting of a longitudinal movement of the blades, in addition to the usual up and down motion. This insures a good rubbing contact so essential in devices of this kind. The springs, being of the best tempered spring steel, retain their elasticity at all times. The switch is well made and of neat design, all the parts being properly proportioned, without giving a clumsy appearance to the switch itself.

THE NEW BERGMANN ALTERNATING ARC LAMP.

One of the distinctive features of the electric lighting industry during the past year has been the marked increase of interest in the subject of arc lighting on alternating current circuits by means of the so-called incandescent arc lamp. The new Bergmann alternating current lamp now being put on the market by the General Incandescent Arc Light Co., of New York, and marks an important step in the march of progress in this direction; important both to the public and electric illuminating companies. As in the case of their direct current lamp, this company manufacture their alternating current incandescent arc lamps in various styles and degrees of ornamentation, from the plainest so-called "Standard" lamp, which is itself sightly in appearance and neat in design, to the most elaborate creations of the metal-worker's art. The accompanying illustrations show two representative forms of these.



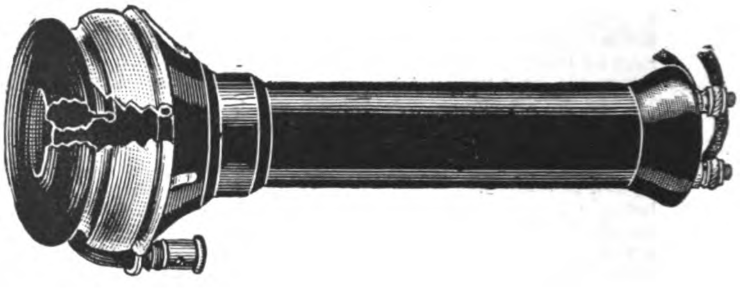
THE NEW BERGMANN ALTERNATING ARC LAMP.

The lamps burn steadily and give as pleasing a light as the successful direct current lamps, and we are informed that all the lamps of this type that the company have thus far shipped are without any known exception giving perfect satisfaction. The company's handsome illustrated circular No. 7, which can be obtained by mail, gives a full account of the claims made for these lamps, some of which may be briefly stated as follows: Simplicity of mechanism, first-class workmanship, absolute steadiness without adjustment, ease of trimming, protection from dust and weather, starting at less than the normal current, requiring no waste of current in resistance, large range of candle power and improved carbon-holders.

The company will have their lamps on exhibition during the Convention, where they will be represented by their general sales agent, Mr. S. A. Douglas, who will go into the details and show all the points of excellence and beauty of the incandescent arc lamp to his numerous friends who may be expected to be present at that reunion of the various electric light interests.

THE COOK PNEUMATIC ATTACHMENT FOR TELEPHONE RECEIVERS.

Mr. V. A. Cook, of Averill Park, N. Y., has invented a pneumatic attachment for telephone receivers shown in the accompanying illustration. It consists of a metal band with spring clamps by which it is fastened to the receiver. To this is fixed a soft rubber cushion with a tube and valve, for inflating it with air. The device is said to be easier upon the ear than the hard rubber receiver. It fits closely and shuts off outside rounds, and also tends to lessen the annoyance from induction effects.



THE COOK PNEUMATIC ATTACHMENT FOR TELEPHONE RECEIVERS.

THE "ACME" STANDARD VOLTMETERS FOR DIRECT AND ALTERNATING CIRCUITS.

FOR some years the Cardew Voltmeter was recognized as the only standard available for alternating circutits. However, as commercial electricity advanced and study was devoted to instrument construction as well as to heavier problems of engineering, it became evident that the Cardew instrument possessed certain defects hitherto unnoticed, as also that an instrument in which these defects were eliminated was urgently required. Recognizing these facts and being convinced of the intrinsic superiority of the "hot-wire" principle, Messrs. Queen & Co., of Philadelphia, through their electrician, Mr. Willyoung, undertook a thorough

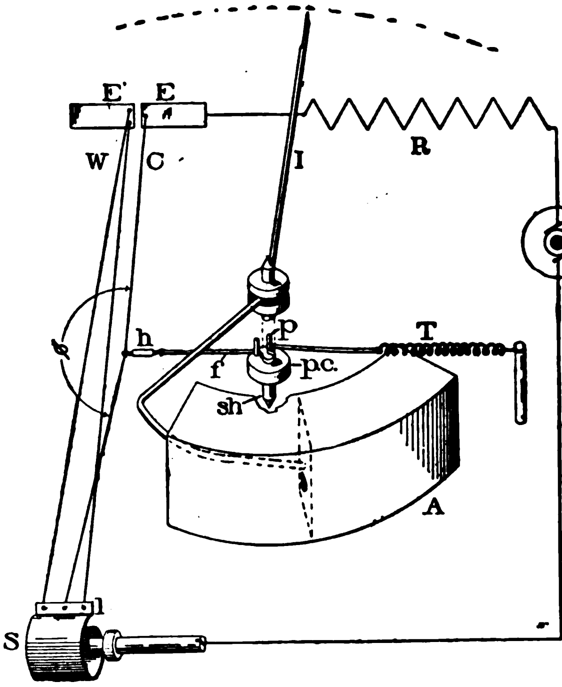


FIG. 1.—THE "ACME" STANDARD VOLTMETER.

study of hot wire instruments with the object of developing a complete series both portable and for station purposes, which should be thoroughly adapted to the requirements of the most exacting practice.

Fig. 1 illustrates, diagrammatically, the essential working parts of the portable instrument. The "hot" or working wire, C, extends from a fixed support, E, to a spirally wound phosphor bronze spring, S. Midway of its length it is connected to the extremity of a phosphor bronze filament or strip, *f*, which passes around the index shaft, *s h*, engaging as it goes with two small pins *p*; the other extremity of the filament *f*, is attached to a spiral "take-up" spring, T, whose outer end is fixed. It is obvious that for a very small linear expansion of the working wire, C, there will be caused a many times magnified movement of the middle point in the line of the filament, *f*, which movement being taken up by T, results in the carrying of the index I over the scale. The wires W, are two or more in number, each of the same or nearly the same cross-section as C, and attached at one end to the fixed plate E^1 similar to E but insulated from it, and at the other end to the spring, S, to which it is attached. These wires, not carrying any current, serve to restrain S from taking up the expansion of C when current is passing, but, being affected by general changes of temperature to the same degree as C, let out S just enough for such changes to take up the linear expansion of C, thus preventing any change of zero of the pointer for varying temperatures. It should also be observed that this compensation is effected instantly no matter how varied the changes of temperature, since the wires W, are of the same or nearly the same cross-section as C. In the Cardew voltmeter the wires W, are equivalented by composite rods of iron and copper having the same coefficient of expansion as the "hot-wire" which gives perfect compensation but only for slow changes of temperature. In all hot wire instruments, however, the temperature of the working wire rises continuously for some time after the current is thrown on since the radiated heat will raise the temperature of the chamber containing the working wire until the rate of radiation from such chamber exactly equals the rate of generation of heat within it. Hence the working wires will continue to expand and the reading to increase unless compensation takes place instantly and one end of the working wire be let out exactly in correspondence with the fictitious expansion, as it may be called. In the same way an instrument compensated with rods will read low if a low reading is made to immediately follow a high reading. In the "Acme" instruments, it is claimed, absolutely no variation in reading can be detected whether the current be on for a second, a moment, or an hour and the readings going to any point from zero are exactly the same as when dropping to the same current value from a higher one. The spiral spring, S, is used in preference to an elongated spring on account of the fact that in an instrument in which the forces involved are so small as in the "Acme" the effect of gravity upon a long spring would be considerable and would cause the readings to be less or greater according as the spring were lower or higher than the other end of the wires and small changes of level would, therefore, have to be guarded against. Upon the form of spring used gravity has no effect and the readings are therefore not appreciably affected by very considerable differences of level; this freedom from level error is greatly assisted by the fact that the index is very accurately made and balanced so as to have its centre of gravity in its axis.

The filament, *f*, is attached to the wire, C, by means of a minute glass connector, *h*, provided at each end with equally minute hooks of platinum wire to interpose between the wire and the filament an effective insulation, thus avoiding any risk of accidental short circuits in other portions of the instrument. A very important function in this instrument is performed by the filament, *f*, and the collar, *p c*, with its pins, *p*. All hot wire instruments, as was premised, give indications practically proportional to the square of the current since the total heat developed in any circuit is C^2 R, and R, in the alloys, varies so little as be negligible in comparison with C. The scales of such instruments, therefore, are exceedingly crowded at first and open up more and more toward the upper end varying in size proportional to C^2.

The particular arrangement of filament and collar just referred to, was devised to secure a fairly uniform scale and it performs its duty admirably. The manner of its operation may best be seen by inspection of Fig. 2, which represents enlarged diagrammatic views of the arrangement at zero and full scale deflection for two different positions of the collar, *p c*, with reference to the pinion, *s h*. The collar, *p c*, carrying the two pins, *p*, can be set upon the pinion, *s h*, so that the angle between the pins *p*, and the pointer may be made anything desired. Referring now to Fig. 2*a* we see that the collar has been so set as to make $\theta = 90$ degrees. This causes the bend in the left hand side of the filament to be very little at the zero point and hence the effective radius of action of this part of the filament upon the shaft, *s h*, to be very short; a very small movement of the working wire is, therefore, considerably magnified by the index. At position *b* of the same figure, however, the bend in the filament has become great and the effective lever arm long. Consequently, the scale divisions which would be proportional to C^2 did the filament simply wrap about a cylindrical shaft are greatly shortened and the general tendency of the whole is to even up the scale throughout its entire range.

Fig. 3 shows one of the perfected forms of this voltmeter, intended for inspectors, engineers, and others having accurate testing to do in various places. The extra resistance R of Fig. 1, is wound (for all ranges above 75 volts) in sections, in coil form and non-inductively, of double covered silk wire thoroughly soaked and baked in shellac. No two neighboring wires can have, therefore, more than 75 volts difference of E. M. F. In order to use as fine a wire for this extra resistance as possible and thus diminish bulk and weight, the extra resistance coil is clamped between two aluminum plates made part of the lid of the instrument, a pair of small flexible leads connecting it with the working wire.

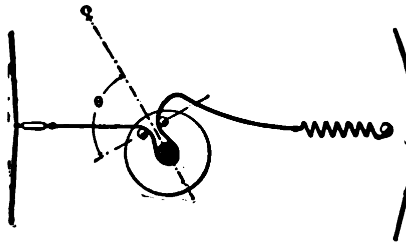


FIG. 2*a*.

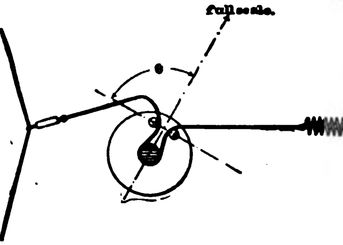


FIG. 2*b*.

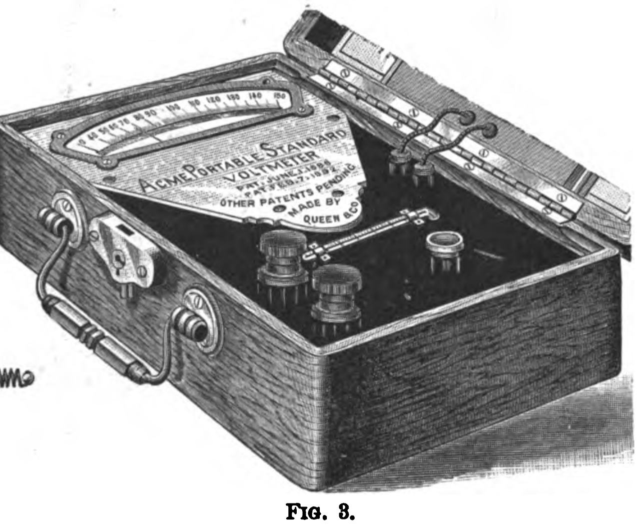


FIG. 3.

THE WILLIAM LANG CO.

An event of general interest in the electrical field, is the change recently made in the management of the above company, which will now have as its officers: T. E. Conklin, president; E. F. Gennert, vice-president; F. W. Belmont, treasurer, and J. F. Cunningham, secretary. The three last named were connected with the firm of E. P. Gleason Mfg. Co. for 22, 12 and 16 years respectively. Mr. Gennert is widely known not only from that association of such long standing, but through his many inventions and improvements in electric lighting, electric gas lighting and other fixtures and details. The factory of the William Lang Co., at 123 to 139 Middleton street, Brooklyn, N. Y., is one of the largest of its kind, and does all manner of stamping and metal drawing. They build in large quantities, and very successfully, automatic vending machines, watch cases, magic pocket lamps, and many other of the little metal novelties that one sees at every turn. The company will now manufacture electrical appliances and fittings, and is constructing and changing machinery for that special purpose. Mr. Gennert and his colleagues have a number of important devices which they will spring upon the market and the public at an early date.

RIES ELECTRIC SPECIALTY CO.

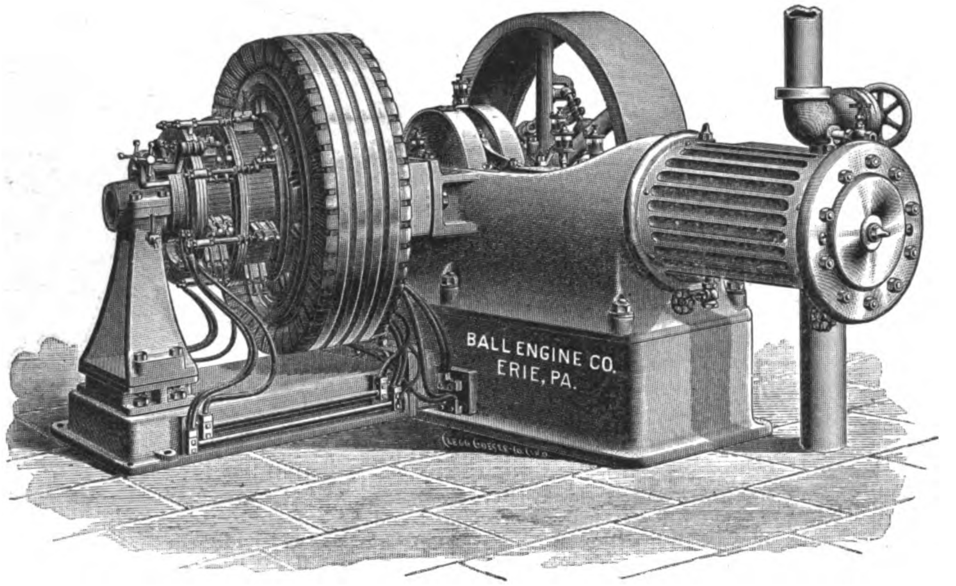
AN invitation to the members of the National Electric Light Association is extended by the Ries Electric Specialty Co., of 7 South Gay street, Baltimore, Md., to visit them at that city for the purpose of seeing the advances made in the development of the Ries & Scott single phase alternating current motors, which are to be put upon the market during the present year.

THE BALL DIRECT CONNECTED ENGINE AND WADDELL-ENTZ GENERATOR.

The progress towards the ultimate perfection of electrical machinery is perhaps manifested in no way more clearly than in the present use of engines directly connected to dynamos. The small floor space occupied is an important consideration in large cities where there is a steadily increasing demand for economy in this direction and a no less important advantage in the elimination of waste of energy by transmission through belts and counter-shafting, leaving nothing but the internal friction of the engine to be accounted for.

The Ball Engine Co., of Erie, Pa., have made a number of installations in connection with various types of dynamos. Among the latest ones are two 200 h. p. cross compound engines, directly connected to Siemens & Halske dynamos in the Lumber Exchange Building, Minneapolis, Minn.; one 125 h. p. simple engine, in connection with a Waddell-Entz dynamo, in the store building of Willoughby, Hill & Co., Chicago; and one 80 h. p. engine, in connection with a Waddell-Entz dynamo, in the building of Cumner, Craig & Co., of Boston. The last of these three is shown in the accompanying illustration. The armature is mounted on the engine crank shaft, which is supported on the end by an outboard bearing resting on an extended sub-base. This is a remarkably compact, durable, and efficient arrangement, and has given the greatest satisfaction in practice.

The distinctive features claimed for this well known engine are: Beauty of design, simplicity and compactness, solidity and strength of frame, large bearings and wearing surfaces, excellence of materials and workmanship. The engine, therefore, is economical and durable, and, being perfectly balanced, will, it is said, run quietly and smoothly under the heaviest and most widely varying loads, with a regulation so perfect that the engine will not vary to exceed one per cent. in speed. Every detail of construction receives the most careful inspection and every engine is thoroughly tested before shipment is made.


BALL ENGINE CO.
ERIE, PA.

THE BALL DIRECT CONNECTED ENGINE AND WADDELL-ENTZ GENERATOR.

PHILADELPHIA NOTES.

THE GENERAL ELECTRIC Co. are installing an electric light plant for Boyd, White & Co., 1330 Chestnut st.

WALKER & KEPLER have received a contract for two Siemens and Halske generators to be installed for Wm. Maine & Co., of 5th and Commerce sts.

HARRY S. SMITH AND CO., LTD., are installing all the electrical work in the new Chemical Laboratory of the University of Pennsylvania. Current will be supplied from the plant in the Engineering Building; a lead-covered cable will run under 34th street from the Engineering Building to the Laboratory. This company report business very fair. They have just completed the installation of two 80 k. w. Waddell-Entz generators direct coupled to Ideal Engines at the Norristown Insane Asylum and will soon have completed the entire electric light installation for the new Hotel Hanover. In this plant Eddy generators and New York Safety engines directly coupled will furnish light for the building. The company have also done the electrical work for the temporary lighting for the Philadelphia Cycle show and a reproduction of "The Midway Plaisance" given at the First Regiment Armory.

THE electric light plant for the Bank of North America will be installed by the Electro-Dynamic Co. The plant will consist of two 30 k. w. Electro-Dynamic dynamos directly coupled to Straight Line engines.

NEW YORK NOTES.

MR. CHAS. E. CHAPIN is now handling the well known Miamisburg dry batteries in addition to his other lines of electrical supplies.

MR. NELSON W. PERRY, E. E., has been awarded the John Scott Legacy Premium and Medal by the Franklin Institute of Philadelphia, for his interesting series electric traction system, which he brought to the attention of the public recently, and to which he made reference in a valuable paper read before the American Institute of Electrical Engineers in 1892.

MR. M. D. VAN BUREN has been appointed chief engineer of the fine new building of the Hanover Fire Insurance Co., 34 Pine street, which will be lighted by 1,100 incandescents. The wiring is in Interior Conduit. The generating plant consists of two Ideal engines driving directly connected General Electric multipolar dynamos with outboard bearings. The boilers are of the Worthington type, made by the New York Safety Steam Power Co. The elevators are Otis.

THE GENERAL ELECTRIC COMPANY will be represented at the Convention by the following gentlemen: Messrs. S. Dana Greene, A. D. Page, J. R. Lovejoy, Wilson S. Howell, F. Todd, A. B. Herrick, R. H. Beach, T. Beran and others. Delegates to the Convention will have the opportunity of examining the new Thomson arc lamp for incandescent circuits, the new recording wattmeters for arc and railway circuits, and several other devices both of economy and novelty.

THE attention of electrical engineers is directed to the "Samson" turbine water wheel built by the James Leffel & Company, Springfield, O. This wheel is furnished in a number of different styles on upright and horizontal shafts and is specially designed and adapted for driving electric lighting and power plants.

MR. W. B. VAN SIZE, who has long been before the electrical public as a patent attorney and expert in electric light, railway, telephone, accumulator and other branches of the art has now established himself independently and has opened professional offices at 44 Broad street. Mr. Van Size has had an experience dating back to and including the practical development of many electrical inventions of importance, and his services have been found highly valuable by more than one of the leading inventors and corporations. Now that his time and ability are at more general disposal, his clientage will rapidly increase.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. MARCH 7, 1894. No. 305.

ELECTRIC HEATING AND ITS RELATION TO CENTRAL STATION WORK.

BY

W. S. Hadaway Jr.

CENTRAL station men are familiar with heating by electricity when applied to the filament of an incandescent lamp to produce light. The only disadvantage of this method of application of electricity is the short period of time the investment is productive capital, necessitating excessively high rates to cover operating expenses and fixed charges. The lamp rate as ordinarily charged on the basis of ten cents per horse power hour, figure $300 per electrical horse-power per year (assuming 300 working days, 10 hours per day.) Mechanical horse power can be freely purchased in populous centres for $75 per H. P. per year, or one-fourth the amount charged for electrical horse power at the lamp rate.

This excess charge is not wholly due to the difference in time during which the plant is productive capital; but we may safely state that if the horse power capacity of the station could be utilized for as much of the time as the average mechanical power plant is utilized, the rate of 5 cents per H. P. hour (one half present average lamp rate) or $150 per H. P. per year would yield larger net profits than are now obtained from lamp rates at the price charged. This claim is substantiated by the power rates of the Edison central station companies. The lamp rate of these companies is nearly on the basis of ten cents per H. P. hour. The power rates are on a sliding scale, with discounts up to 50 per cent. on monthly bills of 1,500 H. P. hours. That is, the user of 6 horse power, 25 days per month, 10 hours per day can purchase an electrical horse power hour for 5 cents.

The logical conclusion is that if the load now furnished by lamps and motors could be increased, especially at the time of light lamp service, the investment would become still more profitable, even at lower rates for the additional power than are at present charged for motor service. That is, if the area between the ordinate and the load line can be greater, and averaged, so that each hour of the day the plant is supplying large units of power, lower average rates will prevail, which will extend the general business, and yield larger net returns.

A well designed central station of moderate size produces a horse power hour by the combustion of about 3 lbs. of good coal. The electrical horse power hour developed by this coal has 2,565 heat units; we have to balance these 2,565 heat units in the concentrated form against 42,000 heat units existant in the three pounds of coal in a more diffused state and determine whether, *for heat purposes*, the difference in the form of the energy, with its enormous attendant losses, compensates for the energy lost in bringing the heat units of coal into the higher form of energy capable of economical transmission to a distance.

It is found in practice that the commercial efficiency of the coal cooking range is somewhere between 3 and 6 per cent.; these limits are stated by Tyndall. In a recent discussion before the London Society of Engineers, Nov. 6, 1893, Mr. Beaumont gives the efficiency of the cooking range from experiments of his own as 3.7 per cent., or roughly 4 per cent., indicating, that of every 27 pounds of coal burned, 26 pounds are thrown away. We have seen that the heat efficiency of the average moderate size central station is about 6 per cent. There is sufficient margin between a heat efficiency of 3.7 per cent. and one of 6 per cent. to warrant the use of electricity as a source of heat in domestic life, and a further extension with apparatus of larger size and higher working economy would give a still greater margin between coal burned under the boiler and that used in the fire-pot of the range. Thus with the use of only 1½ lbs. of coal per h. p. hour he would secure a commercial efficiency of 12.2 per cent. or 3.3 times the efficiency of the range.

At the outset, of course, the cost of electrical energy as fuel under average conditions at the power rate will be greater than fuel directly burned. But there are compensating advantages gained which more than offset the additional cost. This has been abundantly proved in actual practice. The saving of attendance, and of time, freedom from dirt, coolness of the kitchen, absolute uniformity of heat and ability to regulate it, appeal at once to the householder. There is merit aside from novelty in such practice.

The use of electricity for lighting is, of course, greatest in the winter time and least in the summer time; the most desirable uses of electricity as a source of heat are found in summer work, for from the nature of electrical energy, it admits of localization and it is this method of heating that is sought in the summer to reduce discomfort from radiation, etc. Thus by what we may term a "condition of compensation," the central station man has at his command apparatus useful in equal degree in summer and in winter, and the means of securing a larger net revenue at lower rates by using the plant for a larger percentage of the day. The time of maximum cooking being generally the time of least lighting, and vice versa.

In industrial work wherever flames are used to secure localized heat, electricity can be advantageously employed. It is more easily regulated than flame, there are no unhealthy products of combustion, the mean temperature of the shop is lowered, the temperatures are constant, the work is more uniform and the entire system cleaner and more complete. For factory use it is the most desirable form of fuel. In laundries, clothing manufactories, hat factories, silk and all textile fabric mills, shirt factories, rubber goods manufactories, furniture factories, etc., are good fields for the use of electricity for heating. In domestic life no source of heat offers so many elements of value as the use of electricity for cooking and laundry work. There is no discomfort, no noxious gases from combustion, and the temperatures attained are constant, so that the question of the discretion of the cook is eliminated and better results obtained than can possibly be reached from the approximate temperatures of surfaces heated by combustion. It may be fairly stated that people who could afford to do their lighting by electricity could afford to do their cooking and ironing by the same means.

Electricity for heating will be found of the same value to central station electric lighting companies as the use of gas for fuel purposes has proved to the gas lighting companies. Its value lies largely in ability to localize the heat, and it will not be found desirable to use it on a large scale where diffused heat is wanted. High temperatures and small quantities are the proper uses for electricity for fuel. It will, however, meet a want as an auxiliary to the regular heating system, for warming bath and dressing rooms and other small rooms, at times when it is not desirable to use the regular system, say in the spring and autumn months and in chilly days.

Those stations operating from water powers may judge of the applicability of electricity for heating by the foregoing remarks. The cheaper the energy can be sold, the wider the field of application, and with water power the more electricity that can be sold the greater the revenue. With large water powers electricity in competition with stoves may be considered in house heating; but not in large buildings in competition with a good steam or hot water heating equipment.

THE LIMITATIONS OF THE DIRECT CONNECTED DIRECT CURRENT GENERATOR.

BY

J. B. Cahoon

I NOTICE in your last issue, an article on the advantages of direct connected direct current generators, by Mr. W. N. Stewart, in which he makes some very sweeping assertions as to the economical operation of this class of machines, and more particularly of stations supplied with such. It is possible, that Mr. Stewart may be riding a hobby, and is therefore blinded to ordinary commercial facts. For instance, in obtaining his economical results, he states that, "If one belt direct from the engine is used, 10 per cent. is lost; if a counter shaft is used, 18 per cent. is lost;" whereas in actual practice with good belts and a proper system of counter shafting, we may safely take as a conservative estimate of the loss due to the use of belts the following: For horizontal belts direct from engine to machine, 5 per cent.; vertical belts, 8 per cent.; for counter shafting using horizontal belts, 10 per cent.; and using vertical belts, 15 per cent. And again, Mr. Stewart makes the assertion, that with the class of machines he would employ, there would be no burnouts in either field or armature, and there would be less oiling and fewer employees necessary to run the plant, while there would be no loss in the transformers, etc. Evidently, according to Mr. Stewart, it does not cost anything for men to take care of storage batteries and therefore this is not an item of expense in his plant, whereas, we find in everyday practice from stations using storage batteries, that not only the care of them, but also the cost of renewals of the plates and cells, is quite an item of expense.

Again, in attempting to distribute over any wide area by means of direct current, either by three or five wire system from a storage battery, or any other source of continuous direct current, it is obvious that much more copper will have to be laid down than would be the case were resort had to the use of the alternating current at a pressure of one or two thousand volts, and this is particularly the case in the distribution for lighting in small places, where the area to be covered chances to be some little distance from the source of power, as is illustrated by the plant at Peterboro, N. H., a description of which was given in the ELECTRICAL ENGINEER, some little time ago. In a case like this, the direct current generator could not be employed and pay a dividend, whereas the opposite is the case with the alternating plant. Again, Mr. Stewart assumes that such a thing as a direct connected alternator does not exist in actual use, and that those who are using the alternating current are only a lot of ignorant people who are some years behind the times. This is a very decided mistake on the part of Mr. Stewart, as several of the large companies are installing the direct connected alternator at the present time, and have been, for some little time past.

There is another point that should not be passed over, and that is that, from all the data I have been able to obtain in the course of the last two years while particularly seeking for data of this nature, I do not think Mr. Stewart is right, or can be sustained, in making the assertion that the direct connected generator of any or all sizes is the thing to use under all conditions where direct current is to be used; for as a matter of fact, I know of quite a number of instances, where the question as to which would be more economical,—direct connected, or belt driven generators of under one hundred kilowatts capacity,—was settled in favor of the belt driven generator for these small units as being likely to give less trouble and being more economical in the long run. Therefore, it seems to me, the broader ground should be taken, that a machine should be installed of such a kind, either alternating or direct current, and to be belt or direct driven, as may be best suited for the location and work to be done.

As regards the use of storage battery, much has been written on this, and there have been many advocates in its favor, while others have argued against its use; but there can be no question that storage batteries are gradually creeping into use in the American station as an auxiliary to the ordinary apparatus in the same way that they have in Europe, although, it is to be very much doubted if they will ever be as extensively used in the stations here, as they now are abroad.

A STORAGE BATTERY CHALLENGE.

In order to put at rest the conflicting statements circulated as to the merits of their Chloride Accumulator the Electric Storage Battery Co., of Philadelphia, have issued a challenge, inviting all American storage battery manufacturers to enter their batteries for a competitive test. Each competitor is to deposit the sum of $500 and the Electric Storage Battery Co., is willing to forfeit its deposit if its Chloride Accumulator does not prove to be at least 50 per cent. better in efficiency, capacity and durability than that of any of its competitors. Messrs. Houston and Kennelly, electrical experts, Betz Building, Philadelphia, have signified their willingness to undertake the tests and have drawn up a complete schedule of condititions under which the tests are to be carried out. The challenge is open for 90 days from March 1, and parties desiring to enter the tests are requested to communicate with Messrs. Houston and Kennelly. The full conditions of the tests appear in our advertising columns.

ELECTRICAL FIRES.

Mr. Wm. H. Merrill, Electrician of the Chicago Fire Underwriter's Ass'n has recently issued his second report of Committee on Fires, giving 77 instances where fires were caused, or said to be caused, by electricity. The list is very interesting and instructive, showing that in nearly every instance the damage could have been prevented by using better wiring material or by exercising a little common sense in the use of the appliances. Such cases, for instance, as the following are inexcusable and show the necessity of rigid enforcement of some of the underwriters' rules.

"Bell wire tapped to incandescent 50 volt alternating circuit by employees in building, cotton and paraffine insulating covering ignited. Loss considerable."

Other cases show that the rule first suggested by Mr. C. C. Haskins, "Fix it so it can't and it wont," does not get the attention it deserves. On the other hand, an item like the following might as well be omitted from a list purporting to give the fire losses caused by electricity:

"Electric street railway power station. Fire caused by dropping an oil lantern, Total loss."

FAULTS INCIDENT TO THE PROTECTION OF LIGHTING AND POWER CIRCUITS.[1]

BY LUCIUS T. STANLEY AND WALTER E. HARRINGTON.

In the present state of the art there are two common methods of protecting electric circuits, viz.: By means of metallic fuses and by means of magnetic cut-outs.

Metallic Fuses.—To adopt the language of a noted company, which is a large manufacturer of metallic fuses in various forms, "fuse wire is a safety device designed to break the electric circuit when an excessive current passes, and it breaks the circuit because it is heated to a temperature at which it melts." Such a device as is thus defined would be a perfect protector to electric circuits if it were possible to predetermine absolutely—first, the current it will safely carry indefinitely, and, second, the actual current in excess of this safe normal load that will "blow" the fuse *instantly*, under any and all conditions of lapsed time, character of service, etc.

The authors then give a list of the principal causes which render it impossible to devise a metallic fuse that is absolutely and under any and all circumstances a protector to an electrical system, and express their belief that in the present advanced state of the art fuses are not only totally inadequate and inefficent but actually dangerous.

The Magnetic Cut-Out is commonly defined as *a device which opens the circuit at a set strength of current.* In the light of certain phenomena brought forth by experiments made by the writers, they believe that this is not a full and complete definition. In fact they think it is misleading. They then give the general principles governing all the various forms produced by the several manufacturers, including the long-throw knife blade switch, operated by a trip actuated by the armature of an electro-magnet, and a device for blowing out the arc. The arc can be broken by an auxiliary break or by the electro magnetic blowout. The authors then discuss the difficulties encountered with this type of apparatus, and conclude as follows:

A magnetic cut-out which would exhibit a long stride toward ultimate perfection would be a switch operated to open by the *direct action* of a magnet upon the switch bar in such a manner as to cause the current itself to drive the bridge away from the switch plates, thus insuring the quickest possible response to an abnormal current. The break at the switch terminals should be protected by a by-path or shunt across the switch terminals, composed of a fuse wire of a carrying capacity sufficient to carry the current for a period of time ample to allow the switch bridge to reach a point of safety, and of a fusing capacity that will cause it to "blow" *instantly* when the switch bridge has thus reached a point of safety. The magnetic circuit should be so arranged that the point of saturation would be beyond the capabilities of the flux incident to the opening of the switch upon the passage of a current at which it might be set and expected to open. Consequently, when abnormal currents, in excess of that at which the switch was set to open, occurred, the result would be an acceleration of movement of the plunger up to the point of saturation, and the *time element* would thus be reduced to a minimum.

THE IMPORTANCE OF COMPLETE METALLIC CIRCUIT FOR ELECTRIC RAILWAYS.[1]

BY J. H. VAIL.

The author stated that many devices for making the track and earth combined a more complete and low resistance circuit had been resorted to, such as burying copper or iron plates, old rails or old car wheels, and connecting them to the track; or, at frequent intervals, driving iron rods down in the earth and connecting by wires to track; or by making actual connection with wire from tracks to gas and water pipe systems. For *supposed* reinforcement of the track, a bare wire of iron or copper has been used buried in the earth, laid parallel to the track, and connected at frequent intervals; also the *supposed* electrical connection of rails at joints, by bond wires of iron or copper, having only a small fractional part of the capacity of the rail as a conductor.

Frequent tests prove that the earth itself cannot afford the free path for the current that was anticipated. Earth conductivity has been overestimated. Iron and lead pipes, being better conductors than earth, must of necessity carry the current, if no superior path is offered by the method of construction. The natural moisture of the earth hastens the destructive electrolytic action of the current on these pipes. In some soils electrolysis is more rapid than in others. The rapidity of action depends upon the chemical constituents of the soil.

It has been stated that in an electric railway system where a connection has been made to water pipes, the pipes have carried as much as twenty-eight per cent. of the total current. Instances are known where as much as forty per cent. is carried on the pipe systems. It has been proved by test that the electrolytic action of even five amperes of current on an iron pipe is considerable, and that much damage will result in one year. The rapidity of action depends upon the character of soil, amount of moisture and quantity of current; the destructive action is constant and sure. Any system using ground plates, ground rods or substitutes therefor, or bare return track wire buried in the earth, is constructed primarily to utilize the earth as return circuit; when the earth does not afford good return the current is sure to follow the water pipes, gas pipes or other buried conductors offering the path of least resistance. We now see that these prove to have been only make-shift methods to reduce the cost of construction.

With the electric railway, the track forms one side of the consumption circuit, and must be so treated in regard to distribution of current as to utilize its carrying capacity equally with the other side, and thus equalize the delivery of current. The electric conductors composing a system of distribution for electric railways should be so thoroughly well proportioned as to show the minimum variation of pressure throughout the system, even when all the cars are in operation. This equality of pressure is an important requisite for the economical working of the motors. The author has tested electric railway systems operating with a station pressure of from 500 to 550 volts, and showing only 300 to 325 volts on various divisions of the system. Here is a direct loss between dynamos and motor car of over forty per cent. Is it, therefore, any wonder that some roads report extraordinary coal consumption? Such loss in pressure indicates radical faults in the original planning of the system and the distribution of copper. The rail sections are in many systems of ample conductivity to carry more than the requisite current, provided they are perfectly bonded and properly connected by feeders with the dynamos. We must, therefore, bond the rail joint in such a mechanical manner as to maintain perfect electrical contact, and with sufficient metal to restore at the joint nearly the full conductivity as that of the rail itself; and at the same time to give the existing joint plates their present freedom of motion.

For the purpose of comparison, we will assume that iron has six times the resistance of copper.[2] (The actual proportion being 1 to 5.63).

	56 POUND RAIL.		70 POUND RAIL.	
	ONE RAIL.	SINGLE TRACK OF TWO RAILS.	ONE RAIL.	SINGLE TRACK OF TWO RAILS.
Area in sq. inches..........	5.4874	10.9748	6.8593	13.7186
Equal in area to circle whose diameter is in inches..........	2.642	3.735	2.95	5.90
Equivalent in cir. mils. to........	6,980,000	13,960,000	8,702,500	17,405,000
Resistance per foot B. A. units	.00000845	.00000422	.00000679	.00000339
Equivalent to copper resistance in cir mils	1,175,000	2,350,000	1,463,000	2,926,000
Equivalent to copper rod whose diameter is...............	1.13	1.533	1.21	1.71
Safe carrying capacity of iron reckoned at ⅛ that of copper in amperes....	390	780	488	976

NOTE.—In the above statement the areas of rails have been determined by use of the planimeter. The ampere capacity of iron has been based upon the most reliable data obtainable. The author believes that the figures submitted are sufficient for comparison, but cannot guarantee their absolute accuracy.

The following table[3] gives the current strength that can be carried by iron wire, within doors, in still air, and without becoming unbearably warm to the hand; that is, not to exceed a temperature of 50° Centigrade:

B. & S. gauge...........	10	9	8	7	6	5	4	3	2	1	0	00	000	0000	½"	¾"	1"
Amperes................	16	19	21	25	28	32	37	43	50	58	67	77	90	105	117	208	302

These figures serve to show how utterly absurd it is to bond a track of seventy-pound T rails with iron rail bonds No. 4 or No. 0 in size, and to pretend to reinforce their conductivity with a No. 0 iron or even a No. 0 copper wire. It is like laying a twelve inch water main and then putting a one-half-inch pipe alongside to help it out. The author believes that ninety-nine per cent. of the money expended for so-called supplementary wire is absolutely thrown away. The same money expended in other directions will give more adequate return. The track system of all electric railways should really be the positive side or outgoing circuit. It will be readily understood that as the current travels from positive to negative, therefore any arc which occurs between the trolley wheel and the trolley wire will carry metal from the trolley wheel and deposit it on the trolley wire. If the reverse method of connection is made, the trolley wire will lose the metal which will be deposited on the trolley wheel, and in time the strength and conductivity of the wire must be seriously impaired, eventually resulting in breakages.

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[1] Abstract of a paper read before the National Electric Light Association, Washington, D. C., Feb. 27, 28 and March 1, 1894.

[2] Table prepared by G. F. Sandt, E. E.

[3] Data furnished by A. E. Kennelly.

The author here stated that a trial was made four years ago under favorable conditions—not to avoid electrolysis, but to save copper. Physical difficulties of operation were developed which warned the experimenters to avoid the three-wire system in future electric railway work. Having carefully analyzed the whole matter, he now felt justified in recommending the complete metallic circuit as the standard for the best electric railway practice. This can best be obtained by the following method: First. By so bonding the track as to render the rail joints of as low resistance and nearly equal conductivity to the rails, and to execute this work so as to maintain this improved condition; and, Second. The track system must be supplied with insulated feeders leading directly from the bus bars in the station to predetermined points of the track system, and thus offer a perfect low resistance path for this side of the electric circuit, the same as is obtained with the trolley line and the overhead system. All of these features and improved methods have been put in practice by the author.

The item of cost cannot properly be urged as an objection, because where the whole construction requires a large investment, every detail of the work should be so executed as to be permanent and enduring. The track feeder system will be far less costly than the double trolley system. Whether track feeders should be laid underground or erected overhead is a question largely controlled by local conditions and capital available. The author expressed a preference for underground work as being more permanent and subject to the least cost for repairs, and has provided for all contingencies in the following manner: First. By a careful study of the conditions under which a system will be operated; these important points being ascertained with reasonable accuracy, the requisite supply and distribution of current for the service is determined, and the system of conductors arranged to meet the requirements. For the proper supply of electric current, the important underlying principles of the feeder system must be thoroughly understood. Second. The conductivity and current-carrying capacity of the track system is calculated, and a system of insulated track feeders is provided, leading from the switchboard in station and connecting at predetermined points, and with a calculated fall of potential.

A Pipe Attacked by Electrolyzing Currents in the Street.

This will be found to result in reduced fuel consumption, better working of the motors, a most satisfactory reduction in repair accounts, and an improved general economy of the entire system.

In the system of distribution secured by the above method, the use of ground plates, rods or other insufficient methods it needless; the current travels only over the paths provided for it, and electrolysis of gas and water mains is entirely obviated.

REPORT OF THE COMMITTEE ON DATA.[1]

BY H. M. SWETLAND, T. CARPENTER SMITH, E. F. PECK, G. G. H. BLAXTER, C. E. SCOTT, *Committee.*

We are requested to furnish this convention with the facts regarding the amount of coal used in actual practice to produce a given quantity of electricity. The information was obtained by correspondence, and furnished the committee in amperes, volts, and hours on each circuit, and the amount of coal used covering this period, including that used for banking fires, etc. The aggregate electrical output for twenty-four hours was then calculated and compared with the total amount of fuel used, giving the watt-hours per pound of coal. All improbable and apparently erroneous reports were discarded, and the tabulated statement herewith comprises intelligent replies from a large number of the electric stations, including many of the leading corporations. The great saving in operating in large units and running continuously is plainly shown by the report which shows 208 watt-hours

Hours.	Amperes.	Volts.	Watt-hours.	Pounds Coal.	Kind.	Watt hours per lb. Coal.
24	583	115	1,609,070	10,800	slack	150
15½	101	120	187,880	2,940	—	64
14	—	—	386,385	3,755	slack	103
—	—	—	10,989,870	61,155	slack	171
inc. 6	25	1,000	312,000	4,200	—	72
arc.	18	1,500				
inc. 6	800	52	361,800	8,000	slack	45
	6.8	2,750				
9½	200	1,100	2,090,000	39,750	Indiana block	53
24	10	117	259,600	16,420	" "	166
22	879½	1,180				
7	4¼	2,000	59,500	2,000	soft	30
10	225	110	247,500	4,400	slack	56
14½	20	1,046	381,023	7,300	soft	52
7	6.8	1,632				
6	7	2,640	110,880	1,000	pea	110
14.6	—	—	315,360	6 930	slack	46
6.5	—	—	401,249	5,469	"	73
24	39	1,050	982,800	30,852	slack	42
8⅝	9.6	2,068	172,058			
24	296	500	355,200			
15	150	120	270,000	5,925	"	46
13	400	113	587,600	7,000	pekay	95
10	10	810	81,000			
6	300	120	279,000	4,000	—	70
	10	1,050				
8	19	1,000	152,000	1,404	slack	108
8	113⅛	110	99,550	1,584	—	79
7	6¾	560	26,460			
24	4,409	122.1	12,920,186	70,852	screenings	183
inc. 24	84	1,100	2,217,600	38,220	hard sc'gs	208
arc. 24	80	2,000	3,840,000			
pwr. 24	145	550	1,914,000			
inc.	200	125	375,000	7,942	Cumberland and sc'gs	106
arc. —	24	1,550	421,600			
pwr.	—	—	46,000			
15	234	50	189,100	6,000	—	31½
4	6.8	500				
7	285	54¼	283,820	5,450	Ptbg. nut and slack	52
12⅝	268	52				
inc. 24	369	110	974,160	12,267	soft	186
pr. 18	80	500	586,740			
arc. —	—	—	720,000			
inc. 6	200	110	132,000	2,000	bit. slack	67
arc.	10	50	3,000			
6	141	108	91,368	1,400	Lehigh pea	65
14½	26	1,000	377,000	4,200	buckwheat	90
inc. 15	108	1,135	1,838,700	18,600	—	132
power 18	65	525	614,250			
15	60	1,100	990,000	8,960	ant. bkwt.	110
inc. 11	20	1,000	272,250	3,257	Ygy. lump	83
arc. 5½	9½	1,000				
12	28	1,000	336,000	3,500	Pardee soft	96
inc. 13	400	52	552,550	6,000	ant. bkwt.	92
arc. 11	9½	2,700				
16	46	1,070	787,520	6,500	bituminous	121
pwr. 12	160	203	389,760	27,366	Y'ghiogheny	104
inc. 24	775	132	2,455,200			
inc. 8	240	110	211,200	3,000	bituminous	98
arc. 7	8½	1,375	81,812			
inc. 15½	230	104	370,760	3,360	slack and nut	111
arc. 6	8	45	2,160			
inc. 15½	15	52	12,090	6,100	bituminous	88
arc. 13	10	4,050	526,500			
inc. 14½	20	1,000	290,000	6,048	buckwheat	126
arc. 14	10	3,400	476,000			
15	1,600	52	1,248,000	6,500	buckwheat	192
24	373	112	1,002,624	8,190	Pittsburgh	122
14	22⅓	1,000	312,666	2,880	Leh. V. pea	109
7½	310	115	267,375	3,500	bituminous	76
inc. 6½	156	120	121,680	1,681	Cumberland	85
arc. 6	30	120	21,600			
inc. 24	500	112	1,344,000	16,000	hard rice	152
arc. 8	100	9.6	7,680			
pwr. 24	200	225	1,080,000			
16.3	33.56	1,000	547,028	4,805	buckwheat	114
inc. 12	25	1,000	300,000	4,800	bituminous	71
arc. 5	8½	1,000	42,500			
inc. 15	26	1,000	390,000	7,380	slack	68
arc. 7	350	45	110,250			
inc. 7	180	110	138,600	6,760	Sidney	46
arc. 12	9.5	2,700	307,800			
inc. 18	30	1,100	594,000	4,300	buckwheat	170
arc. 12	6½	1,800	140,400			
6½	122	110	87,230	1,400	bit. slack	62
inc. 8	19.25	1,100	284,600	2,000	pea	143
arc.	9.6	1,500				
25	1,200	125	3,750,000	55,420	soft coal	68
10	220	112	246,400	2,100	coal	117
10	217.7	113	246,001	5,320	lump	46
inc. 6	22	1,060	201,120	1,800	—	112
arc.	6.8	1,500				
5	130	112	72,800	1,800	slack	40
9	120	125	135,000	2,400	bituminous	56
10.46	—		1,180,306	16,053	good lignite	73
14	200	110	308,000	12,000	slack	40
11	10	1,500	165,000			
11	20	1,100	242,000	3,200	McAl. lump.	76
7⅓	203	115	171,197	3,640	Iowa slack	47
inc. 14	30½	1,000	501,256	7,500	buckwheat	67
arc.	52	102				
inc 7½	14	54	5,670	3,200	coal	25
arc. 7½	10	1,000	75,000			

Average Watt-hours per pound coal, 91.7.
Where there are blanks in the table, details were not given.

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[1] Abstract of a Report made at the National Electric Light Association meeting, Washington, D. C., February 29, 1894.

per pound of hard screenings where about 8,000,000 watts were generated, running full twenty-four hours, as against the report which claims only 30 watt-hours per pound of soft coal, the total output being less than 60,000 watts and the service being furnished only seven hours. The best reports do not compare favorably with the results secured in generating power for manufacturing purposes.

In order to facilitate this comparison, we have prepared a table based on 90 per cent. mechanical efficiency in the engine and the same efficiency in the dynamo:

Then $\frac{746 \times .90 \times .90}{\text{coal per hour}}$ = Watt-hours per pound of coal. And

Coal per hour per 1 H. P.	Watt hours per lb. of coal.
1.5 lbs. should produce	402.84
2 " " "	302.13
3 " " "	201.42
4 " " "	151.06
5 " " "	120.85
6 " " "	100.71
7 " " "	86.32
8 " " "	75.53
9 " " "	67.14
10 " " "	60.43
11 " " "	54.93
12 " " "	50.35
15 " " "	40.28
18 " " "	33.57
20 " " "	30.22

From this estimate of engine and dynamo loss, 1½ pounds of coal should produce 402.21 watt-hours. We have a report from the Chelsea Jute Mills, of Brooklyn, N. Y., covering a period of six days, where an average of 658.3 indicated horse-power was developed from a coal consumption of 1.482 pounds per indicated horse-power per hour, the load varying from 495.21 to 764.96 horse-power. This equipment consists of Corliss compound condensing engines and vertical tubular boilers. The plant was in operation 10 hours each day. The figures given cover the whole amount of fuel used, including banking, etc. The fuel used was George's Creek bituminous coal.

If our percentage of efficency is correct, and if we could have a fairly uniform electrical output, this plant ought to produce over 400 watt-hours, or double that of the most favorable report given us, more than double that of the next best report, thirteen times the efficiency of the plant making the lowest report, and between four and five times the average efficiency of the whole report.

No attempt has been made in this report to classify equipments, as was originally intended, but with the information here furnished as a basis, the work can be readily classified, additional information secured, and the original scheme of establishing an average basis of efficiency for the several lines of equipment can be carried out. We believe the tendency of the work is to encourage more careful records, which in turn assist in locating and eliminating losses, and we hope future reports by this Committee will show a much better average than 88.4 watt-hours for one pound of coal.

A DRAWBAUGH TRANSMITTER PATENT ISSUED.

Among the patents issued Feb. 20 was one for a carbon telephone transmitter to Daniel Drawbaugh on his application filed July 26, 1880. When the application was made Drawbaugh also applied for another patent on carbon transmitters which would have controlled all use of carbon, but this it will be remembered, was rejected two years ago when the Berliner patent, with which it interfered, was issued. The Drawbaugh Company appealed to the courts from the decision of the Patent Commissioner, and the case comes up for trial on March 12.

The first claim of the present patent is as follows:

> In a telephone transmitter, a diaphragm carrying two resistance varying electrodes electrically insulated from each other, in combination with opposing electrodes mounted upon vibratory supports and provided with means for adjusting the initial pressure between said electrodes.

The Washington Convention would have been noteworthy, if for no other reason, from the active participation of Mr. Samuel Insull as an out-and-out central station man from Chicago, although not long ago he shaped the destinies of one of the biggest manufacturing companies. It is believed that Mr. Insull has, as usual, a shrewd idea of the right end of the business.

President Cleveland has but one predecessor in office living, but President Armstrong had the pleasure of seeing around him ex-presidents Weeks, Perry, Huntley, Morrison and Ayer, all dignified mandarins of the gold button. The presence of these gentlemen was greatly appreciated as testifying to their interest in the Association's welfare.

N. E. L. A. STANDARD RULES FOR ELECTRICAL CONSTRUCTION AND OPERATION.[1]

CENTRAL STATIONS.

CLASS A.—FOR LIGHT, HEAT OR POWER.

These rules also apply to Dynamo Rooms in Isolated Plants, connected with or detached from buildings used for other purposes. Also to all varieties of apparatus of both high and low potential.

The floors of Central Stations should be cleaned thoroughly at least once a week, and especial care taken that oil is not thrown from the machinery, as floors and machinery saturated with oil increase greatly the fire risk.

Oil, waste and such supplies should not be kept in the loft or cellar, and where it is impossible to remove them to a separate building, automatic sprinklers must be installed.

Generators or Motors.

1. Must be located in a dry place.
2. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry.
3. Must not be exposed to flying or combustible materials.
4 Must each be covered with a waterproof cover when not operating.

In no case must a generator be placed in a room where any hazardous process is carried on, such as the working room of a cotton, jute, flax, woolen or flour mill.

Care and Attendance.

A competent man must be kept on duty in the room where generators are operating.

Oily waste must be kept in metal cans, and removed daily.

Conductors.

From generators, switchboards, rheostats or other instruments, and thence to outside lines, conductors:

1. Must be in plain sight.
2. Must be wholly on non-combustible insulators, such as glass or porcelain.
3. Must be separated from contact with floors, partitions or walls through which they may pass, by non-combustible insulating tubes.
4 Must be kept rigidly so far apart that they cannot come in contact.
5. Must be covered with non-inflammable insulating material sufficient to prevent accidental contact.
6. Must be ample in carrying capacity to prevent heating. (See Capacity of Wires Table.)
7. Must be connected by splices or joints equal in carrying capacity to the conductors themselves, soldered, if necessary, to make them efficient and permanent.
8. Must be, when under floors or on distributing towers, placed in spaces ample for inspection and ventilation, and provided with special insulating covering.

Switchboards.

1. Must be so placed as to make it impossible to communicate fire to surrounding combustible materials; accessible from all sides when the connections are on the back or may be placed against a brick or stone wall when the connections are entirely on the face.
2. Must be kept free from moisture.
3. Must be made of non-combustible material, or of hard wood, filled to prevent absorption of moisture.
4. Must be equipped with bars and wires in accordance with Rules 1, 2, 3, 4, 5, 6 and 7 for placing conductors.

Resistance Boxes and Equalizers.

1. Must be equipped with metal or non-combustible frames.

All rheostats for controlling dynamos, motors or devices for electric heating and cooking should be constructed entirely of non-combustible materials.

2. Must be treated as sources of heat.
3. Must be placed on the switch, or a distance of a foot from combutsible material, or separated therefrom by asbestos or cement.

Lightning Arresters.

1. Must be attached to each side of every overhead circuit connected with the station.
2. Must be in plain sight.
3. Must be on the switchboard, or in an equally accessible place, away from combustible material.
4. Must be connected with at least two earths by separate wires of large size.
5. Must be so constructed as not to maintain an arc after the discharge has passed.

Testing.

All series and alternating circuits must be tested every two hours while in operation, to discover any leakage to earth, abnormal in view of the potential and method of operation.

All multiple arc low potential systems (300 volts or less) must be provided with an indicating or detecting device, readily attachable, to afford easy means of testing where the station operates perpetually.

Data obtained from all tests must be preserved for examination by insurance inspectors.

CLASS B.—ARC (SERIES) SYSTEMS.

Outside Conductors.

All outside overhead conductors (including services):

1. Must be covered with some insulating material, not easily abraded.
2. Must be firmly secured to properly insulated and substantially built supports, all tie wires having an insulation equal to that of the conductors they confine.
3. Must be so placed that moisture cannot form a cross-connection between them, not less than a foot apart and not in contact with any substance other than proper insulating supports.
4. Must be at least seven feet above the highest point of flat roofs and at least one foot above the ridge of pitched roofs over which they pass or to which they are attached.
5. Must be protected, whenever necessary, in view of possible accidents to conductors or supports, from possibility of contact with other conducting wires or substances to which current may leak, by dead insulated guard irons or wires. Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.
6. Must be provided with petticoat insulators of glass or porcelain. Porcelain knobs, cleats and rubber hooks are prohibited.
7. Must be so spliced or joined as to be both mechanically and electrically secure without solder. They must then be soldered to insure preservation and covered with an insulation equal to that on the conductors.

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[1] Adopted at the Washington Convention, March 1, 1894.

Note.—These Rules are subject to amendments or alterations, and will be modified from time to time as experience and the exigencies of electrical development demand. All such changes will receive the official sanction of the National Electric Light Association, and be given immediate publicity, upon their adoption.

The following formula for soldering fluid is approved:

Saturated Solution of Zinc	5 parts.
Alcohol	4 parts.
Glycerine	1 part.

Conductors should not be run over, or attached to, buildings other than those in which light or power is being, or is to be, used, but on separate poles or structures always easily inspected.

Service Blocks.

Must be covered over their entire surface with at least two coats of waterproof paint and so maintained.

Telegraph, telephone and similar wires must not be placed on the same arm with electric light or power wires, and should not be placed on the same structure or pole.

INTERIOR CONDUCTORS.

All Interior Conductors.

1. Must be where they enter buildings from outside terminal insulators to and through the walls, covered with extra waterproof insulation and must have drip loops outside, preferably slanting upward toward the inside, and bushed with waterproof and non-combustible insulating tube.

2. Must be arranged to enter and leave the building through a double contact service switch, which will effectually close the main circuit and disconnect the interior wires when it is turned "off." The switch must be so constructed that it shall be automatic in its action, not stopping between points when started, and prevent an arc between the points under all circumstances; it must indicate on inspection whether the current be "on" or "off," and be mounted on a non-combustible base in a position where it can be kept free from moisture and easy of access to police or firemen.

3 Must be always in plan sight, never covered, except in special cases, where an armored tube may be necessary.

4. Must be covered in all cases with a waterproof and, as far as possible, non-combustible material that will adhere to the wire, not fray by friction, and bear a temperature of 150° F. without softening.

5. Must be in dry places kept rigidly apart at least ten inches, except when covered (in addition to insulation) by waterproof, non-conducting and non-inflammable tubing, which must be strong enough to protect the insulating covering from injury. Conductors thus placed may be run not less than three inches apart, and be fastened with staples, under which are placed mechanically rigid insulating strips or saddles of greater width than the metal of the staple, by which possibility of injury to the tube may be prevented.

6. Must be in damp places attached to glass or porcelain insulators, and separated ten inches or more.

7. Must be, when passing through walls, floors, timbers or partitions, treated as in central stations under like conditions.

LAMPS AND OTHER DEVICES.

Arc Lamps.

1. Must be carefully isolated from inflammable material.

2. Must be provided at all times with a glass globe surrounding the arc, securely fastened upon a closed base. No broken or cracked globes may be used.

3. Must be provided with a hand switch, also an automatic switch, that will shunt the current around the carbons should they fail to feed properly.

4. Must be provided with reliable stops to prevent carbons from falling out in case the clamps become loose.

5. Must be carefully insulated from the circuit in all their exposed parts.

6. Must be, where inflammable material is near or under the lamps, provided with a wire netting around the globe and a spark-arrester above, to prevent escape of sparks, melted copper or carbon.

Incandescent lamps in series circuits, having a maximum potential of 350 volts or over, must be governed by the same rules as for the arc lights, and each series lamp provided with a hand switch and automatic cut-out switch; when lights are in multiple series, such switches and cut-outs must not control less than a single group of lights. Electro-magnetic devices for switches are not approved.

Under no circumstances will incandescent lamps on series circuits be allowed to be attached to gas fixtures.

CLASS C.—OVERHEAD CONDUCTORS. INCANDESCENT (LOW PRESSURE) SYSTEMS.—300 VOLTS OR LESS.

Outside Overhead Conductors.

1. Must be erected in accordance with general rules for Arc (Series) Circuit Conductors.

2. Must be separated not less than six inches where they enter buildings as service conductors, and be provided with a double pole fusible cut-out, as near as possible to the point of entrance to the building, and outside the walls when practicable.

Underground Conductors.

1. Must be provided with suitable protecting devices at the ends of tube or conduit service inside the walls of buildings, as a guard against moisture and injury.

2. Must be terminated at a properly placed double pole house cut-out.

3. Must be of specially insulated conductors after leaving the tube or conduit, and separated by at least ten inches, until the double pole cut-out is reached.

Inside Wiring.

Wires should be so placed where practicable that in the event of the failure or deterioration of their insulating covering the conductors will still remain insulated.

At the entrance of every building there shall be a double pole switch placed in the service conductors, whereby the current may be entirely cut off.

Conductors.

1. Must not be of sizes smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G.

2. Must not be paraffine covered.

3. Must not be covered with soft rubber tube.

4. Must not be laid in mouldings of any kind in damp places.

5. Must not be laid in mouldings with open grooves against the wall or ceiling.

6. Must not be laid in mouldings where less than half an inch of solid insulation is between parallel wires, and between wires and walls or ceilings.

7. Must not be laid in plaster, cement or similar finish, without an exterior metallic protection.

8. Mouldings, where admissible, must have at least two coatings of waterproof paint, to be impregnated with a moisture repellant.

Cleatwork.

1. Cleatwork is not desirable, and cleats must not be used unless in a very dry place.

2. Must not be used unless in a place perfectly open for inspection at any time.

3. Must not be used unless they are of porcelain, or well-seasoned wood, filled, to prevent absorption of moisture.

4. Must not be used unless they are so arranged that wires of opposite polarity, with a difference of potential of 150 volts or less, will be kept at least two and one half inches apart, and that where a higher voltage is used this distance be increased proportionately.

5. Must not be used unless there is a backing provided, of wood at least half an inch thick, well seasoned and filled, to prevent absorption of moisture.

Metal Staples.

1. Metal staples must never be used to fasten conductors unless provided with an insulating sleeve or saddle rigidly attached to the metal of the staple, and having such strength and surface as to prevent mechanical injury to the insulation of the conductor.

2. Must never be used to fasten conductors unless under conditions in which cleatwork would be acceptable, or where driven into a moulding specially adapted for open work.

Special Wiring.

Wherever conductors cross gas, water, or other metallic pipes, or any other conductors or conducting material (except arc light wires), they should be separated therefrom by some continuous non-conductor at least one inch. In crossing arc light wires the low tension conductors must be placed at a distance of at least six inches. In wet places an air space must be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run over all pipes upon which condensed moisture is likely to gather, or which by leakage might cause trouble on a circuit.

In rooms where inflammable gases may exist, or where the atmosphere is damp, the incandescent lamp and socket should be enclosed in a vapor-tight globe. This is not to be understood to include rooms where illuminating gases are used in the ordinary manner.

In breweries, stables, dye-houses, paper and pulp mills or other buildings specially liable to moisture, all conductors, except where used for pendants:

1. Must be separated at least six inches.
2. Must be provided with a durable, moisture-proof covering.
3. Must be carefully put up.
4. Must be supported by porcelain or glass insulators.

Moisture-proof and non-inflammable tubing may be accepted in lieu of such construction.

No switches or fusible cut-outs will be allowed in such places.

Interior Conduits.

1. Must not be combustible.

2. Must not be of such material or construction that will be injured by plaster, cement, or other surrounding material, or that the insulation of the conductor will ultimately be injured or destroyed by the elements of its composition.

3. Must not be so constructed or placed that difficulty will be experienced in removing or replacing the conductors.

Must be continuous from one junction box to another or to fixtures, and of non-inflammable material, and of as substantial character as the existing gas and water pipes, in order to afford mechanical protection from injury by saws, chisels or nails.

Architects and builders should provide suitable wireways or openings in all buildings at the time of their construction, in which could be placed electric wires and conduits according to the requirements of the building.

Prior to the installation of the wires, powdered soapstone should be blown through the conduit tubes to facilitate the drawing in of the same.

4. Must not be depended upon for insulation. The conductors should be covered with moisture-proof material.

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors, to protect them from mechanical injury and, as far as possible, from moisture.

Conductors passing through walls or ceilings must be encased in a suitable tubing, which must extend at least one inch beyond the finished surface until the mortar or other similar material, be entirely dry, when the projection may be reduced to half an inch.

Double Pole Safety Cut-Outs.

1. Must be placed where the overhead or underground conductors enter a building and join the inside wires.

2. Must be placed at every point where a change is made in the size of the wire (unless the cut-out in the larger wire will protect the smaller). This includes all flexible conductors. All such junctions must be in plain sight.

3. Must be constructed with bases of non-combustible and moisture-proof material.

4. Must be so constructed and placed that an arc cannot be maintained between the terminals by the fusing of the metal.

5. Must be so placed that on any combination fixture no group of lamps requiring a current of six amperes or more shall be ultimately dependent upon one cut-out.

6. Must be, wherever used for more than six amperes, or (where the plug or equivalent device is not used) equipped with fusible strips or wires, provided with contact surfaces or tips of harder material, soldered or otherwise, having perfect electrical connection with the fusible part of the strip.

Safety Fuses.

Safety fuses must be so proportioned to the conductors they are intended to protect that they will melt before the maximum safe carrying capacity of the wire is exceeded.

All fuses, where possible, must be stamped, or otherwise marked, with the number of amperes equal to the safe carrying capacity of the wire they protect.

All cut-out blocks when installed must be similarly marked.

The safe carrying capacity of a wire changes under different circumstances, being about forty per cent. less when the wire is closed in a tube or piece of moulding than when bare and exposed to the air, when the heat is rapidly radiated. It must be clearly understood that the size of the fuse depends upon the size of the smallest conductor it protects, and not upon the amount of current to be used on the circuit. Below is a table showing the safe carrying capacity of conductors of different sizes in Birmingham, Brown & Sharpe and Edison gauges, which must be followed in the placing of interior conductors.

Brown & Sharpe.		Birmingham.		Edison Standard.	
Gauge No.	Amperes.	Gauge No.	Amperes.	Gauge No.	Amperes.
0000	175	0000	175	200	175
000	145	000	150	180	160
00	120	00	130	140	135
0	100	0	110	110	110
1	95	1	95	90	95
2	70	2	85	80	85
3	60	3	75	65	75
4	50	4	65	55	65
5	45	5	60	50	60
6	35	6	50	40	50
7	30	7	45	30	40
8	25	8	35	25	35
10	20	10	30	20	30
12	15	12	20	12	20
14	10	14	15	8	15
16	5	16	10	5	10
		18	5	3	5

Switches.

1. Must be mounted on moisture-proof and incombustible bases, such as slate or porcelain.

2. Must be double pole when the circuits which they control are connected to the fixtures attached to gas pipes, and when six amperes or more are to pass through them.

3. Must have a firm and secure contact, must make and break readily, and not stick when motion has once been imparted by the handle.

4. Must have carrying capacity sufficient to prevent heating above the surrounding atmosphere.

5. Must be placed in dry accessible places and be grouped, as far as possible, being mounted, when practicable, upon slate or equally indestructible backboards.

Motors.

1. In wiring for motive power, the same precautions must be taken as with the current of the same volume and potential for lighting. The motor and resistance box must be protected by a double pole cut-out, and controlled by a double pole switch.

Arc Lights on Low Potential Circuits.

1. Must be supplied by branch conductors, not smaller than No. 12 B. & S. gauge.

2. Must be connected with main conductors only through double pole cut-outs.

3. Must be furnished only with such resistances or regulators as are enclosed in non-combustible material, such resistances being treated as sources of heat.

4. Must be supplied with globes protected as in the cases of arc lights on high potential circuits.

Fixture Work.

1. In all cases where conductors are concealed within, or attached to, fixtures, the latter must bo insulated from the gas pipe system of the building by an insulating joint, the material of which shall not be affected by gas or changes of temperature.

2. When wired outside, the conductors must be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixtures

3. All conductors for fixture work must have a waterproof insulation that is durable and not easily abraded, and must not in any case be smaller than No. 16 B. & S., No. 18 B. W. G., or No. 3 E. S. G.

4. All burrs or fins must be removed before the conductors are drawn into a fixture.

5. The tendency to condensation within the pipes must be guarded against by sealing the upper end of the fixture.

6. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

7. Each fixture must be tested for possible "contacts" between conductors and fixture, and for "short-circuits" before the fixture is connected to its supply conductors.

8. The ceiling blocks of fixtures should be made of insulating material.

Electric Gas Lighting.

Where electric gas lighting is to be used on the same fixture with the electric light.

1. No part of the gas piping or fixture shall be in electrical connection with the gas lighting circuit.

2. The wires used with the fixture must have a non-inflammable insulation, or, where concealed between the pipe and shell of the fixture, the insulation must be such as is required for fixture wiring for the electric light.

3. The whole installation must test free from "grounds."

4. The two installations must test perfectly free of connection with each other.

Pendants and Sockets.

No portion of the lamp socket exposed to contact with outside objects must be allowed to come into electrical contact with either of the conductors.

Cord Pendants.

1. Must be made of conductors, each of which is composed of several strands insulated from the other conductor by a mechanical separator of carbonizable material, and both surrounded in damp places with a moisture-proof and a non-inflammable layer.

2. Must be protected by insulating bushings where the cord enters the socket.

3. Must be so suspended that the entire weight of the socket and lamp will be borne by knots above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws. All sockets used for wire or cord pendants should have openings at least equal to one-quarter inch gas-pipe size.

4. Must be allowed to sustain nothing heavier than a four-light cluster, and in such a case special provision should be made by an extra heavy cord or wire, as a mechanical reinforcement.

5. Must be equipped with keyless sockets, as far as practicable, controlled by wall switches. In no case may a lamp giving more than fifty candle-power be placed in a key socket on a flexible pendant.

Electrical Heating and Cooking.

In general the same precautions should be taken in the installation and operation of electric heating and cooking appliances as are applicable to circuits for electric light and power.

The practice of attaching heating and cooking appliances to lamp sockets is to be deprecated. Proper circuits must be provided, fully protected by double pole safety fuses and switches, and the appliances themselves should be kept from contact with inflammable materials.

Flexible cords should be used with strands separately covered with non-inflammable insulation, and both wires or strands covered with a waterproofing, and that by a braiding, and especial care should be taken to make proper connections on all appliances, and each should be plainly marked with the maximum volts and amperes they will safely carry.

CLASS D.—ALTERNATING SYSTEMS. CONVERTERS OR TRANSFORMERS.

Converters.

1. Must not be placed inside of any building, except the Central Station, unless as hereinafter provided.

2. Must not be placed in any but metallic or non-combustible cases, which cases should be connected to earth.

3. Must not be attached to the outside walls of buildings unless separated therefrom by substantial insulating supports.

4. Must not be placed in any other than a dry and convenient location (which can be secured from opening into the interior of the building, such as a vault), when an underground service is used.

5. Must not be placed without safety fuses at the junction between main and service conductors, and safety fuses in the secondary circuits where they will not be affected by the heat of the converter.

Primary Conductors.

In those cases where it may not be possible to exclude the transformers and primary wires entirely from the building, the following precautions must be strictly observed:

1. The transformer must be located at a point as near as possible to that at which the primary wires enter the building.

The primary lead of a transformer should be heavily insulated with the highest class insulation, such as vulcanized pure india-rubber of the best quality, preferably covered with a high class outer covering, and such leads should have a minimum length of eighteen inches.

2. Between these points the conductors must be heavily insulated with a coating of moisture-proof material, and in addition must be so covered and protected that mechanical injury to them or contact with them shall be practically impossible.

3. The primary conductors, if within a building, must be furnished with a double pole switch, and also with a double pole cut-out where the wires enter the building, or where they leave the main line on the pole or in the conduit. These switches should, if possible, be enclosed in secure and fire-proof boxes outside the building.

4. The primary conductors, when inside a building, must be kept apart at least ten inches, and at the same distance from all other conducting bodies.

Secondary Conductors.

The conductors from the secondary coil of the transformer to the lamps, or other translating devices, must be installed according to the rules for "Inside Wiring" for "Low Potential Systems."

CLASS E.—ELECTRIC RAILWAYS.

Power Stations.

All rules pertaining to arc light wires and stations shall apply (so far as practicable) to street railway power stations and their conductors.

Railway Systems with Ground Return.

Electric Railway systems in which the motor cars are driven by a current from a single wire, with ground or floor return circuit, are prohibited, except as hereinafter provided:

1. When there is no liability of other conductors coming in contact with the trolley wire.

2. When the location of the generator is such that the ground circuit will not create a fire hazard to the property.

3. When an approved automatic circuit breaker, or other device that will immediately cut off the current in case the trolley wires become grounded, is introduced in each circuit as it leaves the power station. This device must be mounted on a fire-proof base, and be in full view of the attendant.

Trolley Wires.

1. Must be no smaller than No. 0 B. & S. copper, or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

2. Must be well insulated from their supports, and in case of the side or double pole construction, the supports shall also be insulated from the poles immediately outside the trolley wire.

3. Must be capable of being disconnected at the power house, or of being divided into sections, so that, in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen in extinguishing the flames. This rule also applies to feeders.

4. Must be safely protected against contact with all other conductors.

Car Wiring.

All wires in cars must be run out of reach of the passengers, and shall be insulated with a waterproof insulation.

Lighting and Railway Power Wires.

Lighting and power wires must not be permitted in the same circuit with trolley wires with a ground return, except in street railway cars, car houses and power stations. The same dynamo may be used for both purposes, provided the connection from the dynamo for each circuit shall be a double pole switch so arranged that only one of the circuits can be in use at the same time.

Any electric railroad employing a ground return shall under no circumstances take its circuits into any building for light, power or other purposes, save in the case of the power and car-houses of the company.

Where light or power is supplied from the railway circuits employing a ground return for use in the power house or car house of the company, only the highest class of approved insulated wire must be used, the same to be supported on insulators and readily accessible at all times. Inflammable mouldings or casing concealing the wires must not be used.

CLASS F.—BATTERIES.

Primary or Secondary Batteries.

Secondary batteries or accumulators should be placed in a light and well-ventilated place, preferably upon racks, and thoroughly well insulated.

Frequent examinations should be made of the connections and the specific gravity of the solution.

When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as apply to such wires fed from dynamo generators developing the same difference of potential.

CLASS G.—MISCELLANEOUS.

1. The wiring in any building must test free from "grounds" before the current is turned on. This test may be made with a magneto-bell that will ring through a resistance of 20,000 ohms where currents of less than 250 volts are used.

2. No ground wires for any purpose may be attached to gas pipes within the building.

3. All conductors connecting with telephone, district messenger, burglar alarm, watch clock, electric time and other similar instruments, must, if in any portion of their length they are liable to become crossed with circuits carrying current for light or power, be provided near the point of entrance to the building with some protective device which will operate to shunt the instruments in case of a dangerous rise of potential, and will open the circuit and arrest an abnormal current flow. Any conductor normally forming an innocuous circuit may become a source of fire hazard if crossed with another conductor through which it may become charged with a relatively high pressure.

Wm. J. Hammer, *Chairman*; Wm. Brophy, James I. Ayer, A. M. Young, H. J. Smith, *Committee reporting to 17th Convention.*

M. D. Law, *Chairman*; Jas. I. Ayer, Wm. Brophy, Wm. J. Hammer, A. M. Young, *Committee reporting to 16th Convention.*

M. D. Law, *Chairman*; Wm. Brophy, Jas. I. Ayer, Wm. J. Hammer, A. M. Young, *Committee reporting to 15th Convention.*

A. J. De Camp, *Chairman*; M. D. Law, S. E. Barton, Wm. Brophy, T. Carpenter Smith, *Committee reporting to 14th Convention.*

UNIVERSITY OF MINNESOTA.

MR. MORGAN BROOKS, president and general manager of the Electrical Engineering Co. of Minneapolis, Minn., delivered a lecture recently before the professors and students of the Engineering Department of the University of Minnesota, on the Telephone, showing its development from smallest beginnings to its present perfection. The lecture was an able and interesting one.

SEVENTEENTH CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, WASHINGTON, D. C.

The Seventeenth Convention of the National Electric Light Association was held at the Grand Army of the Republic Hall, on Pennsylvania avenue, Washington, D. C., February 27 and 28, and March 1st, 1894.

Prest. Elect. Francisco. Secretary Porter. Retiring Prest. Armstrong. First Vice-Prest. Wilmerding.

(*From a Photograph by Prince, of Washington, D. C.*)

The following were in attendance:

Altoona, Pa.:—J. P. Graham; E. B. Greene; W. Markland.

Anniston, Ala.:—H. W. Sexton.

Atlanta, Ga.:—H. J. Edgar.

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Battle Creek, Md.:—J. B. Foote; J. R. Galloway.

Beverly, Mass.:—Louis McLaughlin.

Boston, Mass.:—F. W. Brigham; Capt. Wm. Brophy; David J. Cartwright; Isaac Davis; H. P. Hall; C. I. Hills; W. S. Hill; A. L. Holden; J. H. Mason; J. M. Orford; J. L. Lucas; D. R. Urquhart; Geo. H. Poor; C. B. Price: E. A. Record; A. C. Shaw.

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Bristol, Pa.:—C. E. Scott.

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Buffalo, N. Y.:—J. J. Flavin; J. F. Kester; C. R. Huntley; F. P. Little; F. H. Williams.

Camden, N. J.:—Hon. E. A. Armstrong; J. J. Burleigh; John W. Lyell; W. E. Harrington; J. R. Williams.

Cincinnati, O.:—J. A. Cabot; C. E. Jones; E. A. Sarran.

Cedar Rapids, Ia.:—W. J. Greene.

Champaign, Ill.:—B. F. Harris.

Chicago Ill.:—Edw. Caldwell; George G. Carter; Ernest L. Clark; W. F. Collins; L. K. Comstock; E. A. Cummings; Fred. DeLand; W. J. Ferris; J. H. Gates; C. E. Gregory; A. W. Harvey; P. H. Hoover; Samuel Insull; F. S. Kenfield; H. S. Manning; Geo. A. McKinlock; J. B. O'Hara; F. L. Perry; E. L. Powers; G. L. Reiman; J. H. Shay; M. J. Sullivan; B. E. Sunny; Edward Stockwell; F. S. Terry; F. Todd; C. H. Wilson; C. H. Wilmerding; M. M. Wood.

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Olean, N. Y.:—George Tobes.

Paterson, N. J.:—Wm. M. Brock; J. Noonan.

Parkersburg, W. Va.:—C. C. Martin.

Philadelphia:—W. Annear; J. Appleton; Sanford Belyen; C. E. Bibber; J. G. Biddle; C. A. Bragg; H. J. Buddy; Henry Clay; H. A. Cleverly; H. B. Cutter; F. W. Darlington; A. J. De Camp; F. R. Ford; J. C. Gardiner; Felix Haac; J. S. Hinds; H. G. Kellogg, Jr.; J. R. Lovejoy; A. H. Manwaring; A. J. Martin; J. McLeer; J. A. Pentz; Eugene Richter; P. G. Salom; T. Carpenter Smith; N. D. Webster; J. R. Williams; E. W. Wilkins; E. T. Wilkinson; E. G. Willyoung; W. B Wood; Peter Wright; G. A. Vallee; Thos. Spencer; R. B. Smith; James Garnett; G. H. Fisher; W. S. Andrews.

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Providence, R. I.:—M. J. Perry.

Ravenna, Ohio:—C. L. Rodman.

Richmond, Va.:—Thos. W. Brander; Maurice Hunter; Maurice W. Thomas.

Rochester, N. Y.:—F. M. Hawkins; Geo. A. Redman; C. F. Burns.

Rockford, Ill.:—M. A. Beal.

Rutland, Vt.:—M. J. Francisco.

Salem, O.:—Joel Sharp; D. L. Davis; G. A. Barnard.

Savannah, Ga.:—T. P. Keck.

Schenectady, N. Y.:—A. B. Herrick.

Springfield, Mo.:—W. H. Fellows.

Steubenville, Ohio:—Joseph Gwynn.

St. Louis, Mo.:—J. I. Ayer; Louis Nahm; J. H. Rhotehamel.

Swissvale, Va.:—C. F. Ellis.

Syracuse, N. Y.:—H. J. Gorke; J. L. Hinds; W. J. Morrison; A. P. Seymour.

Taunton. Mass.:—O. L. Mitchell.

Toledo, O.:—C. R. Faber, Jr.

Toronto, Ont.:—Frederick Nicholls.

Trenton, N. J.:—J. T. Ridgeway.

Vineland, N. J:—Prof. W. A. Anthony.

Warren, O.:—B. B. Downs; W. D. Packard.

Washington, D. C.:—C. H. Bowen; F. G. Bolles; Geo. S. Boudinot; A. W. Clapp; Prof. O. Dodge; Hon. A. C. Durborow, Jr.; Allen R. Foote; M. D. Law; Geo. C. Maynard; Robert Watson; A. Young; J. R. Ash; J. Burkett; C. F. Chrisholm; F. H. Clarke; G. G. Dennison; S. Q. Hayes; J. D. McIntire; Prof. Mendenhall; F. D. Neale; Chas. Pardoe; Wilmot Lake.

Waterbury, Conn.:—Alden M. Young.

West Chester, Pa.:—J. E. Pyle.

Wheeling, W. Va.:—E. Buchman; H. H. Dunlevy; E. M. Holliday.

Wilkinsburgh, Pa.:—John J. Jennings.

Wilmington, Del.:—C. R. Van Trump; F. D. Sweeter; W. Shaw.

Worcester, Mass.:—H. H. Fairbanks.

Youngstown, O.:—R. P. Holmes.

The following ladies were in attendance:

Mrs. W. A. Anthony; Miss E. W. Armstrong; Mrs. C. O. Baker, Jr.; Mrs. C. E. Bibber; Mrs. C. A. Bragg; Mrs. J. J. Burleigh; Mrs. Willard A. Candee; Miss Candee; Mrs. Louis Cassier; Mrs. H. E. Cooke; Mrs. Wm. Cooney; Miss Cumming; Mrs. A. J. De Camp; Miss DeCamp; Mrs. L. A. Doud; Mrs. H. A. Foster; Mrs. James Ferguson; Mrs. M. J. Francisco; Mrs. W. J. Hammer; Mrs. H. G. Issertel; Mrs. W. J. Johnston; Miss Johnston; Mrs. Romaine Mace; Mrs. Geo. T. Manson; Mrs. A. H. Manwaring; Mrs. G. A. McKinlock; Mrs. Orford; Miss Morris; Mrs. J. Noonan; Mrs. A. H. Paterson; Mrs. E. F. Peck; Miss Essie Read; Mrs. E. W. Seymour; Mrs. R. L. Shainwald; Miss Bessie Shütte; Mrs. H. J. Smith; Mrs. M. J. Sullivan; Mrs. F. D. Sweeter; Mrs. H. M. Swetland; Mrs. Schuyler S. Wheeler; Mrs. J. Wright; Miss Vail; Mrs. G. A. Vallee.

TUESDAY MORNING SESSION.

PRESIDENT ARMSTRONG, of Camden, in calling the convention to order and welcoming the members, said he might be counted remiss did he fail to congratulate them specifically as well as generally. The past year had been a very trying one on electrical enterprises. As they were among the settled businesses of the country, the newest and therefore the most elastic, they had felt the financial stringency worse than many others, but they had not been without cheer and encouragement during it all. Figures from the most reliable sources, show that there are now upward of 2,300 central stations in this country, representing at least two hundred millions of capital. Involved in electrical manufactures and supplies of various kinds, are as many millions more; this employing as it naturally does hundreds of thousands of men, supporting hundreds of thousands of homes, adding to the material wealth, prosperity and happiness of our people, made them, as representatives, trustees of a great and responsible trust. There had been a tendency in the last few months, however, toward a revival, largely instigated, he thought, by the representatives of our large manufacturing corporations, of the agitation of municipal ownership of electrical light plants. He sincerely believed that to be a bad policy for the city, as he had always maintained. He believed it to be a worse policy for the manufacturing concerns that advocate it. But no city could ever afford to do an unfair thing. Municipal ownership had been somewhat more earnestly revived in his section of late, than it had been for many years, and he read an editorial from the *Philadelphia Public Ledger*, upon this question, advocating careful consideration, and fairness to existing companies by municipalities. He strongly advocated concerted action in cases of this kind. Financially the association was in admirable condition; its debts all paid and money in the treasury.

A letter of regret was read from Col. Thurber, Secretary to President Cleveland, stating that owing to the absence of the President from the city, it would not be possible for him to meet the delegates. Mrs. Cleveland also regretted her inability to meet the ladies accompanying the gentlemen in attendance upon the convention.

Mr. E. J. Hall, Vice-President and General Manager, tendered the delegates the use of a Long Distance telephone which had been specially put in on the ground floor of the Ebbitt House, by the Long Distance Telephone Company. President Stevenson, of the Metropolitan Railroad Company, of Washington, issued complimentary tickets good on the cars of his company, to those in attendance at the convention. The Cosmos Club, of Washington, extended the courtesies of its club-house to the delegates. On motion, a vote of thanks was tendered for the above courtesies.

Letters of regret at their inability to be present were read from the following gentlemen: Thomas A. Edison; George Westinghouse, Jr.; Nikola Tesla; Chas. A. Coffin; Thos. D. Lockwood; Prof. E. L. Nichols, of Ithaca; Prof. Henry T. Bovey, of Montreal; Gen. Charles L. Knapp, of Montreal; Elihu Thomson, Lynn, Mass.

THE PRESIDENT announced the next order of business to be the

REPORT OF THE COMMITTEE ON LEGISLATION.

MR. C. H. WILMERDING, Chairman, of Chicago, regretted that his Committee had no formal report to make. Since his appointment as Chairman of the Committee no important information had reached them in regard to legislation affecting electric light interests, although there has been a great deal of that sort of legislation threatened.

MR. W. J. MORRISON, of Syracuse, said he was informed that there was a bill now pending before the Legislature of the State of New York authorizing the Board of Water Commissioners of any incorporated village in that State, having a water works system belonging to the village, to establish a lighting system within said village for the purpose of supplying light, by means of gas, electricity or other approved system, to the inhabitants of said village. It was a matter, he thought, which deserved the attention of the Association in some form.

MR. HUNTLEY and **MR. DE CAMP** thought the Committee ought to be discharged as being too large, and a smaller one appointed.

MR. CLAY, of Philadelphia, suggested that the Association employ a competent person to compile the electric legislation of the several States.

MR. SAMUEL INSULL, of Chicago, thought the functions that should be performed by the Committee on Legislation should rather be that of preventing legislation detrimental to the members, than compiling legislation that was past.

MR. STETSON, of New Bedford, Mass., said that in his state they employ a competent attorney who watches the proceedings all the time.

On motion the resolution of Mr. Clay was referred to the Executive Committee, to report thereon.

THE PRESIDENT announced the next report in order to be that of the Committee on Finance. **MR. JOHN A. SEELY**, the chairman, read the report, which showed the finances to be in satisfactory condition. On motion the report was accepted and ordered to be filed.

The next order of business announced was the Report of the Committee on Relation between Manufacturing and Central Station Companies, Mr. Frederick Nicholls, of Toronto, Chairman. The report was postponed to be discussed in executive session.

THE PRESIDENT then introduced Dr. Richard J. Gatling, the inventor of the Gatling gun, who addressed the Convention briefly.

MR. W. J. HAMMER referred to the high rates of postage on society publications and suggested that the National Electric Light Association appoint a committee to present a protest in this matter. **THE PRESIDENT** appointed Messrs. Adams, Young and Gwinn such a committee.

TUESDAY AFTERNOON SESSION.

THE PRESIDENT called the meeting to order at 2.30 p. m.

MR. M. J. FRANCISCO moved that Vice-President A. E. Stevenson be invited to attend the sessions and that a committee be appointed to notify him. **THE PRESIDENT** appointed Mr. Francisco and the members of the Reception Committee, as such committee, to include Messrs. Baker and Seely.

The President announced the first business of the afternoon session to be the **REPORT OF THE COMMITTEE ON DATA**,[1] which was read by **MR. H. M. SWETLAND**, of New York, Chairman.

MR. SWETLAND added that the did not secure reports from the best stations, and that the average might have been lowered materially. He also pointed out that of two thousand inquiries sent out they received replies from something like eight hundred, and less than one hundred suitable for their purpose. This report seemed to develop one idea, and that is, the necessity of more accurate records in central stations.

MR. BURLEIGH thought seven pounds of coal per horse power hour far from a fair average. **MR. NICHOLLS** thought the result of the collection of this data went to show that electric light plants must be singularly inefficient.

MR. J. H. VAIL, of New York, believed that in order that a report of this kind should be fully understood, it should give a classification of the equipments, and of the quantity of the coal. The 88.4 watt-hours per pound of coal equalled about seven pounds of coal per h. p. per hour. He knew of a large number of stations, probably a hundred, running about on that basis, and fifty other stations which were producing a horse power hour for four pounds of coal, and had been doing it for several years. Other stations of recent construction were producing a horse power hour for an average of two pounds of coal.

MR. T. CARPENTER SMITH as the result of his experience believed that any station using ordinary engines non-condensing, non-compound and doing it on seven pounds of coal per horse power hour, including banking and perhaps running on an economical load six or seven hours in the evening was doing very well. The report gave the average. The majority of these stations could be very much improved with a little extra care. He thought a great many of the members did not reply to the circular, with the idea that it was giving away their business. The Committee wanted it clearly understood that nothing of that kind was involved. The returns are tabulated and then buried.

MR. VAN TRUMP, of Wilmington, Del,, believed that with a station that is burning three pounds of coal per indicated horse power per hour, it was impossible to get 201 watts on the line. He did not think any central station engineer who is running on three pounds of coal could get more than 186 watts out on his line, from which these results are tabulated. **MR. SWETLAND** agreed that the 90 per cent. of efficiency in the dynamo meant directly at the machine; and no loss by resistance in the wire on the circuit was taken into consideration.

THE PRESIDENT called for the **REPORT OF THE COMMITTEE ON UNDERGROUND CONDUITS AND CONDUCTORS**. None having been prepared the committee was discharged.

THE PRESIDENT announced the next order of business to be the **REPORT OF THE COMMITTEE ON RULES FOR SAFE WIRING**.[2] Copies of the report of the Committee were distributed but the discussion was postponed until Thursday morning.

MR. W. E. HARRINGTON then read a paper on **FAULTS INCIDENT TO THE PROTECTION OF LIGHTING AND POWER CIRCUITS**.[3]

MR. WHITE, of Evansville, Ill., in answer to questions stated that he had used magnetic cut-outs inside his station on a 2,000 volt 25 ampere alternating circuit for three years.

MR. W. J. HAMMER described the Cunningham mercury cup magnetic cut-out used by Swinburn in his high tension experiments.

MR. ROBERTSON, of Minneapolis, had had considerable trouble with fuse wires on his alternating circuits but since the introduction of magnetic cut-outs he had had no trouble. He had been looking for a device in the nature of a magnetic cut-out which would do away with fuses. He found it at last and had been using a magnetic cut-out on his five hundred volt power circuit and it had never failed to act in time to save a machine.

MR. WHITE had found it a most efficient protection against

(*Continued on page 208.*)

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[1] See page 200.
[2] See page 201.
[3] See page 199.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - -	per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies, - - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

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Vol. XVII. NEW YORK, MARCH 7, 1894. No. 305.

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CONVENTION THEMES.

If any doubts have existed as to the continued interest taken in the proceedings of the National Electric Light Association they will be dispelled by the record of the meeting which we print in this issue. The most marked indication of this increasing interest is to be found in the lively discussions, and indeed, though not lacking in good papers, the Washington Convention may be said to have been pre-eminently marked by its varied and excellent discussions. Without exception the topics and papers were of an eminently practical nature and reflect great credit on Secretary Porter to whose efforts in this respect the success of the Convention was largely due.

Of the Reports, that of the Committee on Data ought to be closely studied by every station manager. While the average figure of fuel consumption in central stations, namely 7 pounds of coal per horse power hour, is based on but a small fraction of the whole number of stations in actual operation it is sufficient to indicate that there is much improvement possible in that all-important source of expense. The reports from numerous stations show what may be done in this direction, and while engineers have not yet arrived at the best figures attained in marine engine practice, they are gradually approaching the 2½ lb. limit. The Committee on Rules on Safe Wiring submitted a set of Standard Rules which will it is hoped bring order out of the somewhat chaotic state that has existed for some time owing to the conflicting rules issued by plagiarizing boards of fire underwriters in different sections of the country. The rules adopted if conscientiously carried out will leave the insurance men little basis for the repeatedly threatened increase in rates on buildings lit by electricity. That the Association's work and influence is extending is shown by the very proper reference in the new rules to electric railway construction, more particularly to those systems embodying a ground return. Perhaps the most far-reaching in its effects is that referring to the non-admission of electric railway circuits for any purpose whatever to buildings other than the power and car houses of railway companies. While the rule is eminently a proper one from the standpoint of safety alone, for which it is primarily intended, its effects go beyond and strike at a practice which ought, as a general thing, to be discouraged, and that is, the furnishing of light and power to private consumers by electric railway companies. Happily this class of work has not yet become general, but with the rule above mentioned enforced, it will, we hope, put an end to a business to which electric railway companies are not entitled and which, in their own interests, they ought to avoid.

As might have been expected, the members of the Association were on the *qui vive* for Mr. Huntley's report of the results obtained by him with a circuit of fifty arc lamps fitted with the Howard device for prolonging the life of the carbon. Mr. Huntley's report unfortunately did not give the many inquiring members the actual cost of operation which all were so anxious to learn, but the actual results obtained must be considered to be distinctly hopeful considering the newness of the device. The Howard lamps on exhibition both indoors and outdoors at Washington afforded a good opportunity for watching them in actual service, and their work compared very well with that of the usual open arc. The latest development of this work to which we alluded in our last issue and which was brought before the convention by Mr. L. B. Marks, that is, the high potential arc, makes it evident that we have not heard the last of this new method, and the next convention will probably give us the figures which were so ardently clamored for. That arc lighting from the commercial standpoint is by no means inactive was demonstrated by the truly remarkable statements of facts and figures brought out during the discussion on arc lamps on incandescent circuits. If the operators of central stations distributing current at low potential are still in doubt as to what can be done in the way of increasing their profits, the record of the work accomplished by Mr. Barstow in Brooklyn, with 2,700 already installed and 400 more ordered ought to be sufficient. We must confess that we hardly expected to find the showing so good but the reasons for the increased economy of running arc lamps from incandescent circuits leave no room for questioning the accuracy of the statements made. Principal among these is probably the fact that, as shown in one instance at least, current can be manufactured and delivered to the low tension main at 25 per cent. less cost than to a high potential circuit. This of course is primarily due to the fact that thus far arc light machines have barely exceeded 100 h. p. in capacity while there appears to be no practical limit, so far as power is concerned, to the construction of low potential machines. To this must be added the superior efficiency of the low tension machines and the less care required by them.

This also brings us to another question discussed at the meeting, namely, "The Most Economical Size of Arc Machine." But one opinion seemed to prevail as to the expediency of employing the largest machines the manufacturers would guarantee. Unfortunately the limitations of insulation will prevent the attaining of arc machines much over the present largest sizes, and even if Prof. Crocker's 10,000 volt machines should become commercially available they would only bring the maximum capacity up to 200 arcs for a single machine.

It was humiliating indeed to hear on the floor of the Convention the admission that American arc lamps do not compare well with those abroad on the score of steadiness, and that the fault does not lie in the mechanism, but in the quality of the carbons employed. This is all the more humiliating as it is difficult to conceive a combination of circumstances more favorable to the production of good and cheap carbons than those which obtain in this country. We have the coke of the oil stills, practically a by-product, and close at hand the natural gas to heat the furnaces. There are thus but two explanations possible for the failure of American manufacturers to produce good carbons,—either they do not know how, or, if they do, sufficient care is not exercised in the manufacture. Neither of these reasons, however, is excuse or adequate explanation for the present condition of affairs and it is such cases as these that make us sigh for a little temporary free trade. We have little doubt that with carbons on the free list, those of our own manufacture would soon drive any of foreign make out of the market on every point of advantage.

Of the papers read at the Convention that of Mr. Charles F. Scott particularly opens up a new field and adds a new chapter to the controversy between the two and three phase advocates. It is a chapter of peace and amity, however, as Mr. Scott shows how both systems can be combined to act to the best advantage. Mr. J. H. Vail's paper also served to draw attention to a condition of affairs to which electric lighting interests should be alive, since electrolysis due to grounding of circuits is an evil but too well known to the central station manager, and has probably been as fruitful a source as any among those which have brought the electrical and the insurance interests into conflict in the past.

The discussion on "Meter vs. Flat Rates" served to bring out an undeniable preference for the meter, which is further proof of the advancing confidence of the public in electric lighting. The influence of the substitution of the meter as against the flat rate on the income of the station, instances of which were mentioned, is a matter which those managers still working on the old basis will do well to consider carefully. It is apparent that the days of the flat rate are numbered and that no regrets will be felt at its final abandonment. The relation of the customer to the central station in the matter of lamp renewals also gave opportunity for calling attention to a practice which requires guarding against where customers furnish their own lamps. It was shown how, by the customer's employing lamps of low efficiency, the current drawn from the station might be largely in excess of that which would be called for with a more economical lamp. This would seem to indicate that where the practice obtains of requiring customers to furnish their own lamps, the latter ought to be under the careful observation of the lighting company, as indeed is the case in most instances. Every company should encourage the use of high efficiency lamps.

In the matter of station economy Mr. Edward Weston in the discussion of Mr. A. B. Herrick's valuable paper, drew attention to the electric losses which may occur right within the station when the current output is heavy, and which ought to make station managers look carefully to the character of joints on the switchboard, as well as to the character of their station instruments.

On the whole the convention was a great, an even remarkable, success. It showed the Association to be more useful, more influential, more prosperous than ever. It has now rallied to its support the old low-tension direct current element that once avoided its meetings; it has broadened its field of work; it has reached out, legitimately, on one side to electric heating and cooking and on the other hand to electric railway work. One of these fine days we shall have the electric light and street railway associations meeting together by pre-arrangement at the same time and place, for co-operation and mutual support. More than one of the members of the N. E. L. A. who have watched its career from the beginning have been gratified at this Washington meeting to observe how substantial and dignified has become the nature of its membership and attendance, and how steadily year by year the general character of its work gains in value. But it must now go out to draw in a larger membership, until like other kindred associations it can boast of as much as 25 or 30 per cent of the operating companies as within its fold. Then the Association will be in a position for good whose strength cannot be overestimated.

lightning. This device was similar to that described by Mr. Hammer.

Mr. T. C. Smith's rule has been to begin with the lightest fuse that will carry the load, and then run it long enough to satisfy oneself that the work is all right; he then takes out every one of those fuses and puts in a fuse that will thoroughly protect the smallest wire nearly up to the carrying capacity of the wire; the blowing capacity of the fuse being just short of the carrying capacity of the wire.

Capt. Wm. Brophy, of Boston, had tested fuses and found they would become red hot before they would let go. Fuses were a broken reed on which to lean. While nearly all fuses were ready to combat with an abnormal flow of current, none of them would stop the sneaking current. The present method of classifying fuses was all wrong. The fuses may be put in a building for a ten or sixteen candle light and afterward changed for a thirty-two. Of course the same fuses would not serve.

Mr. Vail:—Magnectic cut-outs on lighting circuits have been used frequently in Schenectady works of the Edison Company in the testing of dynamos, and can be adjusted very accurately. It appears to me that there must be a difference made between the cut-outs that can be used in a central station and the cut-outs in a private house or isolated plant. In regard to the action in the fuse to which Mr. Smith referred, it is due to oxidation. The fuse is made of soft metal, and is usually placed under a binding screw of brass. The metals are different, and oxidation will in time result. The only way to prevent that, in my experience, is to have a hard metal end soldered on the fuse—such as a brass or copper tip on the fuse. If the fuse is put into position clean it will be found that the hard metal will prevent the oxidation, and no difficulty will occur in that way. Captain Brophy is undoubtedly correct in the statement he makes in regard to replacing small fuses by large fuses. I brought that to the attention of the Edison people some years ago, and I sent some inspectors to examine the central stations. I found a great many instances where circuits of six lights, which had been properly fused in the first instance, had been replaced by a fuse for thirty lights, or a ten light circuit by a forty light fuse.

Mr. Smith:—The oxidation under the heads of the fuse is not what I am afraid of. The instances I referred to always take place in the body of the fuse. It is undoubtedly due to some oxidation, which makes the skin of the metal not very destructible by the heat; but it is something new to me to hear they come that way from the manufacturer. In regard to the replacing of fuses, I happen to know of one fire that was caused by the owner of the house himself.

Mr. Hammer thought a good deal of trouble might be obviated if a three-cornered file were taken and run across the fuse. It made a weak point and caused a tendency to blow out at once if there was an overload.

Mr. J. M. Orford:—Our method of fusing is to use the simple, ordinary fuse which we buy in the market. We have magnetic cut-outs on some of our dynamos, but we use also a fuse and switchboard for each circuit, besides the magnetic cut-out to protect the dynamo. Every time we branch from the main we put in a fuse, and every time we put a converter up we put in a fuse. We find little trouble with them, except when we get to larger sizes. The capacity of a fuse is an unknown quantity. I find on the market a fuse made of aluminum, which is going to be the fuse of the future, in my opinion, because it is extremely thin, and any undue heat generated seems to melt it quickly. They stamp on each fuse its capacity.

Capt. Brophy:—I am not one of those who believe that electricity is responsible for fires; not for one atom of the fires it is made responsible for by the public. I have been in a position to investigate fires that were said to have originated in electric current, and not one per cent. of the fires could be traced to that cause. The percentage of fires caused by electricity has been insignificant, for years; they are usually caused by matches and kerosene.

Mr. Nicholls:—I would like to ask if any members here have had experience in measuring by meters power supplied for elevators. In starting an elevator you may use 110 volts, and 40 to 80 amperes, and after the elevator gets started this will run down to 12 or 15. Has any one had any experience in measuring this current? There was a contract awarded for operating some elevators in a government building by electric power, and the government refused to make a meter contract, and insisted upon a flat rate, because the weight of the expert evidence which they secured was to the effect that no meter at present in use would accurately record the current, with such sudden fluctuations.

Mr. Harrington:—I have had a wattmeter on street cars, which present about the same conditions, and the amount of the current recorded was so absurd—two or three amperes—that we abandoned it. The instrument would not record the fluctuations of street car work.

Mr. Carnes, of Memphis, had used such a method only upon a 500 volt current; his experience had been variable; the general result had been to discourage him from the further use of the meter in such cases.

The President then introduced **Prof. T. C. Mendenhall**, of Washington, who addressed the meeting on the subject of "Units of Electrical Measure." The speaker briefly reviewed the work in this direction accomplished by the International Electrical Congress at Chicago, and urged early action to have those electrical standards officially adopted here before they are adopted abroad. A bill had already been introduced in Congress with this object in view and the Secretary of the Treasury had been urged to approve their adoption for use in all departments of the government.

The Chicago Congress had been urged to officially define the 2,000 c. p. lamp, but agreed that the time had not yet come for this definition.

An invitation was read from the Rock Creek Railroad Co. tendering the use of its lines to the delegates. The invitation was accepted with thanks. The meeting then went into executive session.

WEDNESDAY, FEB. 28—MORNING SESSION.

The President announced the first order of business to be the paper on "The Importance of Complete Metallic Circuit for Electric Railways,"[1] which was read by Mr. J. H. Vail.

At this point a beautiful basket of flowers was placed on the platform, accompanied by a letter from the "Wives, Sisters and Sweethearts of the N. E. L. A.," expressing their thanks for the drive through the city on the previous afternoon.

In answer to a question by **Mr. Burleigh**, **Mr. Vail** said he believed that with the insulated wire bond they could get entirely clear of electrolysis in the pipes and that he did not regard a fish-plate of any permanent value at all in bonding. He had had no experience with welded rail joints, but thought there were many physical difficulties in the way which would prevent their success.

Mr. Burleigh: My reason for asking the question was that a gentleman from Boston told me a few days ago that they had perfected the system of welding rail joints, especially as they welded them on the fish-plates instead of on the rail itself.

Mr. Ch. Wason, of Cleveland, stated that the first attempts at electric rail welding in Cambridge, Mass., were not a success; but that improved methods were now being adopted. In his opinion rail bonds would never do away with electrolytic action. It must be done by a continuous rail, of the ninety pound section, which most street railroads are putting down. The joint and the wheel of the motor were the two things that street railway men had now got to contend with. If some one could get a wheel that would not wear out, and the electrically welded joint apparently looked as if it would always stand, the street railroad men would bless him.

Mr. M. D. Law, of Washington, agreed with Mr. Vail in all he had said about making his track as complete a metallic circuit as possible, but pointed out that that condition was fully met by the Love conduit trolley system operated in Chicago and Washington, described in our last issue.

Mr. C. Cuttriss, of New York, electrician of the Commercial Cable Co., spoke of the trouble experienced in the company's lines which were grounded at Coney Island, close to an electric railway system. The potential over the marshes measured higher by about one-tenth of a volt in every thirty feet. The difference kept on increasing, being from zero at the Island to eight or ten volts at New York. One could imagine what the effect of this would be on a sensitive instrument. The remedy had now been applied, but no telegraph company would be able to get a natural and pure earth again until the electric railroad systems get a metallic return instead of a ground return.

Capt. Wm. Brophy said that certain railroad companies had been introducing loops from their trolley systems to furnish light and power. He had fought that steadily, believing that it was dangerous, not to say that they were encroaching on the field that properly belonged to the electric light companies. It was unsafe to introduce loops from a grounded trolley system into any building for the purpose of furnishing light or power. The Rules which would be submitted to the meeting took strong grounds against this method of lighting. He did not believe rail welding would be a success.

Mr. T. C. Smith referred to experiments made with rails solidly butt-ended and the good results obtained. **Mr. Wason** confirmed this by his experience on a section of track in Cleveland.

Mr. Harrington believed that the best plan to overcome the difficulties is to use a solid butt with a flexible bond, with the butt welded to the rail, and do away with the imperfect contact which has usually been employed.

Mr. J. A. Seely drew attention to the desirability of having the rail lengths as long as possible. The original lengths were thirty feet; they now turn them out as long as one hundred feet.

The President announced that the subject of

STORAGE BATTERIES

was the next topic of discussion.

Mr. Wm. Bracken, of New York, opened the discussion. He said that peace now reigned over the storage battery interests in this country. The companies had come in under one flag and were united for a common interest so that one could purchase a storage battery to-day with the confidence that he was not going to be annoyed by threats of suits for infringement. He had also had the representatives of several foreign companies here this summer and gotten a great deal of useful information from them. As to the nature of the guarantees, any person desiring to install a storage battery plant in his station could readily satisfy himself as to the life of the plant. He did not think there was any company asking more than 10 per cent. for the cost of maintaining the battery. He had no doubt that experience would prove the cost of maintenance to be less.

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[1] See page 199.

Dr. P. G. Salom, of Philadelphia, said that the question of the advisability of the use of storage batteries at the present time in central station plants was purely a commercial one. Would it pay?

In order to answer this question intelligently, the first requisite was to have a unit or standard. In other words, Given a standard engine and dynamo of the average size used in central stations, what is the cost per kilo-watt hour or ampere-hour? Having determined this cost, based on a given price for coal and labor, each central station operator can determine at the end of the year how closely he approximates this ideal cost by dividing his total output into his total operating expenses, and further by keeping careful records he can also determine what factor or factors are operating to prevent his attaining the ideal results. Having determined all these factors for his own individual case it becomes a simple question of arithmetic for him to determine whether, with an additional investment for a battery with a given output and efficiency and at a given cost for maintenance, he can advantageously add to his plant a storage battery. No hard and fast rule can be adopted. No two central stations are alike either in equipment or output, and therefore, the best size of battery equipment or proper proportion of battery to other units may never be exactly the same in any two cases. They were now prepared to give responsible guarantees that the maintenance of the battery should not exceed a certain reasonable cost per annum. He added that the life of a battery under reasonable working conditions is directly proportional to the amount of lead used in its construction. He would undertake to build a storage battery that would last one hundred years if people were willing to pay for it.

Mr. J. Appleton, Philadelphia, said the previous speakers had gone over the general ground concerning the use of storage batteries in central stations and had said what might be done. He would like to draw their attention to something that had been done in this country and which spoke for itself. He referred to the storage battery plant which the Electric Storage Battery Company who manufacture the chloride accumulator had recently installed for the Germantown Electric Light Company, and which he described, and of which he gave the following figures:

Saving on the one year's running in labor, coal, water, oil, waste, etc., not counting the decreased depreciation of machinery due to shutting down from daylight to dusk was $2,500. Besides this there was a great advantage in being able to overhaul and examine all machinery in the day time while everything was shut down. This was on the first battery installed having 800 ampere-hours capacity. This being so satisfactory and the behavior of the battery being equally good the Germantown company decided to put in a battery of 2½ times this capacity which would enable them to increase their day load and consequently increase the savings, as the cost of charging a large battery is only the extra fuel required. This larger battery was installed at the beginning of this year. The battery consists of 120 cells of the chloride type G eleven plates in each, arranged 60 on each side of the 3-wire system; the capacity of each cell is 1,000 ampere-hours or 2,000 ampere-hours with both sides; the normal rate of discharge is 200, maximum 400, and this can safely be increased in case of sudden demand or emergency. One special feature of these cells is the size of the plates, viz., 15″ x 15″.

Mr. Appleton then gave a brief outline of the battery as handled, and stated that with a properly designed and installed battery such as that at Germantown the maintenance and depreciation would not exceed that of the other portion of the central station plant. He also pointed out that outlying districts could be reached by storage battery substations, fed by high potential cnotinuous current.

Mr. Charles R. Huntley, of Buffalo, then addressed the meeting on

ARC LAMP TESTS,

embodying the results of a test of the Howard incandescent arc-light.

Mr. Huntley stated that it was not his purpose at this time to explain the merits or demerits, if there be any, of the appliance, but to give the results of his experience. He assumed absolute control of the circuit on February 4, and put it into the hands of one of his men, giving it the same care and attention that he did the forty-two circuits running from the station. They patroled the circuit at night from the hour of burning, 5.45 p. m., till 7.10 in the morning. A representative of the company was with the trimmer. The test was made originally of fifty arc lights upon a circuit, and the dynamo was a No. 8 Brush machine, of the latest type, with the following results:

> "Feb. 7; Ferry corner Grant St. out 1.10 a. m.; started itself two minutes later. Feb. 8; circuit flashed badly until 12 p. m.; started lamp Elmwood and Summer streets 9.45 by switching off and on, started same lamp 3, 4 and 5.30 a. m. Carbon burned out 3.10 a. m. Ferry and Richmond. Started Ferry and Grant 1, 2 and 3 a. m. by pulling cable. Stop on clutch too high and lowered arc spring one turn. Feb. 9, 10, 11, and 12, lamps O. K. Feb 13; put on new cylinders on four lamps. Feb. 14; lamps O. K. Feb. 15; carbons burned out of four lamps. Feb. 16; trimmed circuit, used thirty-three cylinders. Feb. 17, 18, 19 and 20, lamps all O. K., renewed fourteen cylinders and trimmed circuit. Feb. 21, 22, and 23, lamps all O. K., trimmed lamp Plymouth street, cylinder broken."

Referring to report of February 8, that night believing that they might run more lamps than the fifty lamps in the circuit, they had installed in the station ten lamps with the appliance on them, and had five lamps thrown in the circuit, but the circuit flashed so badly from the additional load of the five lamps upon the dynamo, that they cut them out and then the circuit went on, and they no longer tried to burn more than fifty lights on the circuit. As to the large number of renewals of the cylinders on the 16th, on that night and the date previous they had a very heavy storm of soft snow, about 18 inches of snow fell. The hood or storm protector of the lamp was of such a character that much of the snow flew in and as the water struck the appliance or globe, which is intensely hot, of course, it broke. The general characteristic of the light was somewhat different to the eye of the public from that of the ordinary arc lamp. The rays of the light were not as strong, but after the circuit was in good burning order it was found that the street was better lighted owing to the horizontal ray of the arc than by the ordinary arc which gave an intense light underneath but did not diffuse the light into the middle of the block. The burning of the lamp or carbons was such that they formed no crater as they do in the ordinary arc, but burn very slowly and with square ends. The claim of the maker was that they give a luminous body caused by the carbon monoxide gas; up to the present time it had worked very well in Buffalo.

In answer to a question by **Mr. De Camp**, **Mr. Huntley** stated that the machine would carry ten more open air arcs than enclosed arcs, that the consumption of the carbons was uniform and that the lamps required trimming every four days with a special carbon. The residents were well satisfied with the illumination; perhaps better than they were with the other circuit. Mr. Huntley could give no estimate of the saving in cost due to the method as all the apparatus, carbons, etc., had been furnished him free for this trial.

Mr. De Camp inquired as to the difference between the Howard device and that of the Baxter lamp of eight or ten years ago.

Mr. L. B. Marks, of New York, said that in looking over the patent situation on this question, he found, as Mr. De Camp had said, that arcs of this type were run years ago. The question which suggested itself was, Why were they not successful? There was first the blackening of the globe, due to the carbon, and the explosions due to the gases generated, owing to lack of means for its exit. Within a month, or two, they would present to the technical electrical world a solution of the gas question, the control of the gases, and a remarkable phenomenon, which had never been presented to the electrical world before, so far as his knowledge went, or as far as the opinion of some scientists with whom he had consulted was concerned, showing that by a slight change in the management of the gases and in the control of the arc they are enabled to prolong the life of the negative almost indefinitely. In fact, in the report of the test which came from their laboratory, the consumption of the negative was zero. One of the papers (The Electrical Engineer, Feb. 28) reported the life of the negative 200 hours per inch. His experience had been that with the change in conditions the life of the negative was 200 and 300 hours per inch. If we have an arrangement such that the enclosed gas has an opportunity to escape, but the ingress of the air is practically prevented, the pressure on the inside of the cylinder is less than the outside. If the pressure on the inside of the cylinder were greater than the pressure on the outside, we might expect an explosion; but under the conditions mentioned, he failed to see how it was possible, under any circumstances, in the normal operation of lamps on a commercial circuit to explode the cylinder. He put himself on record as stating that he had never known a cylinder, with a plug and controlling arrangement for the gases, as used in the Howard type, to explode; and he thought he might refer to Mr. Howard, who was the pioneer in the development of this new type of enclosed arc, that in his experience he had not known of a case of explosion. The results of tests according to his observations were slightly different from those of Mr. Huntley, regarding the shape of the tip. The crater was not exactly flat, but it extended over the entire surface of the carbon, being slightly hollow. The distribution of light was the important feature of this lamp, and he referred to some recent tests of Prof. G. D. Shepardson as bearing out his conclusions that with a small cylinder and a very thin coating they obtained a greater diffusion of the light than with a ground glass or milk glass globe. He also referred to the discussion of Professor Nichols, at the Chicago International Electrical Congress, who stated that the Howard arc gives a diffusion of light without loss of efficiency, which is not the case with opal or ground glass globes. Mr. Marks warned the members of this Association against remarks of certain carbon men which are intended for a specific purpose.

The meeting then adjourned until 2 P. M. After adjournment the delegates were photographed standing on the steps of Willard's Hall.

WEDNESDAY AFTERNOON SESSION.

The Convention re-assembled at 2:30 o'clock p. m.

Mr. De Camp resumed the discussion of Mr. Huntley's paper and was inclined to think that the system tested was not seductive to the station man. As to the question of saving in labor, he thought that even if the lamps did not require actual re-carboning, it would be necessary to inspect them as often as they were now trimmed.

Being called on by Prof. Anthony, Mr. L. E. Howard said that in regard to cleaning the light rod, the requirements changed with this new equipment. Instead of 8$\frac{1}{16}$ inches for part of a night's run, there is less than an inch of the rod that is used. No doubt in trimming the lamp it needed inspection after the first trimming; but having started properly, the adjustment of the lamp and its mechanism being fitted to the requirements, it needed no further attention until the run was completed. In regard to saving, it had been reported to him that the basis of income was to be the royalty. Such was not the case. It was proposed to furnish this equipment to the central station at a fixed price, guaranteeing a saving on the two items of carbon and trimming to be at least twenty per cent. on the present cost. In the matter of breakage, all new enterprises were obliged to go through a certain amount of experimental work. There was no additional cost for carbons to the central station; in fact it would cost them 20 per cent. less.

In answer to further questions Mr. Howard said that the lamp took about 62 volts and consumed the same energy in watts as the ordinary lamp.

Mr. Smith had used the Howard device and the diffusion was better. The amount of light furnished by the lamps was the same as with the old lamp. But at a distance they found that they got a better light. Having trimmed the light the first night it worked beautifully, but the next night it would not start. They tried to get rid of that by stiffening the carbon and while the lamps did not actually wedge, the alignment of the carbon was not good enough to admit of their running more than one night without trimming. The man did not have to trim, but he had to climb the poles to see that the carbons were right, and the whole attention to those lamps practically took as much time as would the trimming. But he judged the saving of one or two trimmers and the patroling would pay for the extra trouble. Mr. Smith also gave his experience with the Baxter lamp ten years ago, which frequently exploded its globe.

Mr. Howard, gave the reasons for the failure of the Baxter lamp; the vents were in the wrong place, and the construction of the cylinder itself, or jacket, was radically wrong. An ideal coating on the cylinder which they were using to-day increased the light. He had frequently known of cylinders to be in constant daily use for over thirty days without being touched in the way of cleaning. There was no residuum or final dust. There was a large percentage of safety and insurance against breakage outside of globes, and a material saving in the negative carbon of a double lamp; and also a percentage of saving in the wear and tear in the mechanism of the lamp.

Mr. Smith had proved by experiment that if a globe be etched on the inside instead of on the outside no light was lost. He also referred to a test of incandescent lamps etched on the inside which show 102 per cent. of the candle power of the unetched lamp.

Mr. C. R. Huntley was thoroughly satisfied that the diffusion of light was as good to any citizen that might look at it, as the open arc light, and he was not sure but that it was better. He was only speaking now of his experience in using the lamp out of doors, but the question came up, whether you can leave an arc light up four or five days subjected to the winds and weather, exposed to the small boy with the air-gun trying to shoot the globe off or to kill a sparrow.

Mr. Stetson said that in this twenty per cent. of saving ought to be included the dockage by the police for lamps out. If there could be a deduction of twenty per cent. on that, the Howard lamp was something they ought to have especially if the lamp was better for commercial purposes in stores.

The next subject taken up was:

WHAT IS THE MOST ECONOMICAL SIZE FOR ARC DYNAMOS?

Mr. C. R. Huntley stated that he had stations equipped with with various sizes of machines. If he were to place an order tomorrow he would try to get a 100-light machine for his stations. As to the danger, he did not think there was any additional; in fact nobody knew the difference, not even themselves when coupling two 60-light machines together. If he could get that power in one machine designed as efficiently and as free from burning out the armatures, he would be in favor of a larger unit. He was working an 80-light machine, and he would not like to be on record as advocating less than a 100-light unit, if he could get it.

Mr. Geo. A. Redman said he was in favor of large units but was prohibited by the city ordinance from going above 3,500.

Mr. J. I. Ayer had carefully noted and kept record of the line troubles on the different circuits, and the records on 80-light circuits showed no greater trouble than those on 60-light circuits. He operated for about two years and a half about thirteen 80-lighters. In a station where the number of lamps in operation would justify the use of the large units, he thought there was no question as to what should be used.

He had made some experiments with two 60-light circuits coupled together for sixty days, and did it in wet weather purposely. He found in a line with 130 lights, with two 60-light machines, that it was dangerous in the station. The current could be detected on the ground, by touching the insulator with a wet towel. In his experience one could not run any higher than four or five thousand volts on a circuit. It was a matter of insulation, something they hoped to overcome. An 80-light dynamo was perfectly practicable, however.

Mr. De Camp said he had long advocated large machines and had been running a 120-light Brush machine in his station for about three weeks, and so far as his experience had gone it was in every respect as feasible and as efficient as the 60-light machine.

The President announced as the next topic

HOW TO RATE ARC LAMPS.

After a preliminary discussion a resolution on the subject by Mr. Burleigh was referred to a committee of five consisting of Prof. Mendenhall, Prof. Anthony, Prof. Forbes, Mr. Weston and Mr. Hammer, with instructions to report at the following morning's session.

The President then, following the programme, inquired:

WHAT IS IT YOU WISH TO KNOW?

Mr. De Camp inquired whether the use of the battery in the Germantown plant had done anything more than to save the loss which the station showed while it was running on an unprofitable day circuit; or, in other words, knowing what the profits or results of the station were previously to the introduction of the day business, had the real substantial results increased since the introduction of the batteries in proportion to the increase of their business, or had the battery simply been a saver of what was lost?

Mr. Nicholls wanted to know if any advantage could be gained in his station which had a day load of 600 amperes and a night load of 700 or 800 amperes.

Mr. Wright, who is connected in a semi-official capacity with the Germantown Electric Co., said that the amount of their total loss by the entire incandescent business, which was composed almost half and half of direct current 220 volts and alternating current 1,100 distribution, was exactly the amount paid for the day circuit. The amount of saving had been stated as somewhere around $2,500; that saving was only figured on the rougher items, and from memory. The amount actually saved by the year's operation of the storage battery amounted to $700. The average output on each size was from 30 to 40 amperes from dawn to dusk. There was one point about this battery that ought to be mentioned, viz., that at Germantown the number of lamps wired was double the dynamo output. If they were going to do as well this year as last in the way of extension, they would have to look out and put in more direct current machinery. The depreciation was figured at 25 per cent. The new battery showed that it had earned about thirty-five per cent. on the amount of the investment during the year it was in operation. Of course, the conditions were experimentally favorable. The reason for this heavy depreciation lay in the fact that the first battery was overtaxed, and they proposed to avoid that in the future by using the newly installed battery of 2½ times the capacity.

Mr. Blackstone hoped that some of those batteries might be installed in the Brooklyn station. He also stated that the price of storage batteries was less in America to-day than in England or Germany.

Mr. Nicholls inquired how much of a battery would be necessary to take the peak of his load in winter nights 3 or 4 months of the year and take the whole night load during the remaining months.

Mr. Williams answered that he would have to know the precise conditions. As regards depreciation it was not fair to take 25 per cent. as the regular figure. According to Mr. Barstow 6 per cent. was a fair figure taken in Europe.

Mr. Nicholls said that while foreign competitors would guarantee 6 per cent. American manufacturers allowed 10 per cent., making a difference in the imported battery of four per cent. per annum. That should be taken into consideration.

The Convention then went into Executive Session.

THURSDAY, MARCH 1.—MORNING SESSION.

The meeting was called to order by Vice-President Francisco. The paper by A. B. Herrick on "The Development of Switchboards for Modern Central Stations," which was the first order of business, was read; being accompanied with stereopticon views.

In the discussion of Mr. Herrick's paper, Mr. Weston inquired why 20 degrees was taken as the standard of temperature? Mr. Herrick replied that it was an easy and ready method of determining whether the instruments were overheated; and the condition of emissivity and radiation are about the same for all the appliances.

Mr. Weston:—Some one has said that whatever is, is right.

Most of us that have lived very long have failed to appreciate the truthfulness of that statement. I think if the author of that statement had visited a few of our central stations and examined the switchboards and determined the amount of energy lost in the stations in this country he would never have uttered it. There are two ways of looking at that matter of loss; first, you may look upon it as the loss of what it costs to produce the energy that you lose; second, you may look upon it from the standpoint of what you could get for it if you sold it. To the business man the latter view is by far the more correct and more important, because, obviously if he gets 12 cents, which is about the average, I think, in this country, per kilowatt hour for the energy delivered to the consumer, that which he loses in the frittering away process in the conductors really represents a decrease in his revenues at that rate. This matter of central station switchboards is becoming more and more important every day, and the present board is unquestionably not the practice that will be followed in the near future. It will be totally changed and the appliances proposed by Mr. Herrick will in the comparatively near future be entirely abandoned; there is no question about this when station managers begin to realize how much they lose even on their switchboards.

I have made some calculations based on a selling price of 12 cents per kilowatt hour, and I have furthermore assumed that that kilowatt hour is maintained 24 hours a day, 365 days in a year. If you want to modify that you can do so to suit your particular condition. It is comparatively easy to ascertain just what you are losing; the general practice is to adopt about a million square mils per 1,000 amperes. In ten feet of such a conductor there would be a drop of one tenth of a volt with a current of 1,000 amperes. Now that looks rather small,—one-tenth of a volt; but expressed in dollars and cents at the end of the year it amounts to a great deal. On the plan proposed it amounts to $12.48 for every ten feet of that conductor. If you take a conductor of ten times that cross-section and ten times the strength of the current, viz., 10,000 amperes, it amounts to $1,124 per annum. Therefore, it is better to say that a fall of potential in a conductor ten feet long, of one circular inch, involves the loss of about $100 per year if run continuously. If it involves that loss in that conductor of course it involves the same loss in any other branch of the conductor,—any extension of it.

This question of loss at the switches is one that is something amazing. I had occasion a little while ago to examine two switches carrying 8,000 amperes. At the joints of the switch there was a drop of 240 millivolts; multiply that by the number of amperes, 8,000, and you will see that there was nearly two kilowatts in the joints. Continue that two kilowatts at 12 cents an hour during the year and it amounts to thousands of dollars. That was only the joints. There was an actual drop at the switch of 360 millivolts,—they want some severe reformation there that is sure. In the ammeter there was a drop of nearly two-tenths of a volt, with nearly 8,000 amperes, and the total loss in that one instrument and switch figures very closely to $5,000 a year. If there were about 30 or 40 instruments in the station you could see what it would amount to at the end of the year.

The ammeters themselves, every one of them, and the feeder ammeters take a large amount of energy; and everything possible should be done to reduce this loss to a minimum. I have selected one example which shall be nameless. This ammeter was a good deal better then the average, so far as efficiency, or economy more properly speaking, is concerned. This was a 600 ampere ammeter —a comparatively small one and in the conductor there was a loss of 21 watts. That looks rather small when the instrument was running at its full rated capacity; it amounts to a quarter of one cent per hour on the basis stated; that is six cents a day and amounts to a little over $22 in a year, but if you have ten of them it means $222. But that ammeter had joints in it and these joints were not well fitted, and there was a further loss in the joints which we will leave out of consideration at the present time. To use that ammeter it would require an average of ten feet of conductor to carry the current to and from it. In that conductor there would be a loss of 64.2 watts; the instrument and conductor together would represent $89 waste of energy on the basis stated. A very good form of ammeter of 600 ampere capacity required 18 watts to operate it; now that 18 watts ought to be got rid of, you can eliminate it if you use a shunt type of instrument properly designed. Do not use a specially constructed shunt but take the actual necessary drop of potential to utilize it to work the instrument, and the instrument which consumed 18 watts, practically consumes .0021 of a watt, and instead of costing $18 per year to run it, it costs you .22 of a cent. The result of this is that the switchboard should be brought as near to your dynamos as you can possibly get them; every inch of unnecessary conductor should be left out. Every joint should be left out that possibly can be and when joints are made they should have large surface contacts. When you make conductors do not make them in circular form, but make them flat. Give the conductor plenty of air so that there can be an abundance of the cooling action of the atmosphere. It is clear that the stations should be so arranged that your feeder circuits are as short as they can possibly be. Your switches must be made very differently from what they are now; polished brass looks pretty, but it is not what you want; do not sacrifice good qualities for appearance. Your conductor should be given plenty of space, they should not be laid flat on one side of the switch board, placed upon a slab, and closed at the bottom. Keep the temperature of the conductors down as low as you can; I do not know but what it would pay to put an oil bath around your conductors, and cool the oil by water.

MR. CHARLES F. SCOTT then read a paper on "Polyphase Transmission."[1]

THE PRESIDENT announced that discussion on the paper would be deferred until the afternoon session.

On motion of Mr. De Camp, the President appointed the following gentlemen a committee of five to make nominations for officers for the ensuing year: Messrs. De Camp, Weeks, Seely, Ayer and Carnes.

On motion the meeting adjourned until 2:30.

THURSDAY AFTERNOON SESSION.

PROF. ANTHONY, on behalf of the Committee on the Rating of Arc Lamps, presented the resolution drawn up by the Committee, which, after slight verbal changes, was adopted, as follows:

> Recognizing the difficulty, if not impossibility, of measuring with any degree of accuracy, the illuminating power of arc lamps, and the great necessity for a more precise definition and statement of the obligation of the producer of electricity for illuminating purposes to the consumer thereof, be it
>
> *Resolved*, That in the opinion of this convention, what is ordinarily known as a 2000 candle power arc lamp is one requiring on the average four hundred and fifty watts for its maintenance, the measurements being made at the lamp terminals where no sensible resistance is included in series with the arc. In case such resistance is used it must be excluded in the measurement of the voltage.
>
> (Signed)
>
> T. C. Mendenhall, *Chairman:* W. A. Anthony, George Forbes, Wm. J. Hammer, Edward Weston.

The Report of the Committee on the National Electric Light Association's Standard Rules for Electrical Construction and Operation was then taken up and after slight verbal changes was adopted.[2] On motion it was ordered that the rules be copyrighted.

The meeting then resolved itself into executive session.

EXECUTIVE SESSION.

MR. DECAMP Chairman of the Committee on Nominations, presented the nominatians for officers for the ensuing year as follows:

PRESIDENT, M. J. Francisco, Rutland, Vermont; 1ST VICE-PRES'T, C. H. Wilmerding, Chicago, Ill.; 2d VICE-PRES'T, Frederick Nicholls, Toronto, Canada. EXECUTIVE COMMITTEE: Chas. R. Huntley, Buffalo, N. Y.; A. J. Markel, Hazelton, Pa; W. W. Carnes, Memphis, Tenn.

Ballots were duly cast, and the gentlemen nominated were unanimously elected.

On motion of MR. JAS. I. AYER, the following resolutions were unanimously adopted.

> WHEREAS:—The success of the meetings of the National Electric Light Association depends in no small measure on the transportation facilities provided between the homes of the members and the various convention cities, and
>
> WHEREAS:—Mr. C. O. Baker, Jr., as Master of Transportation, has for many years, with great ability and generous devotion of his time and energies, presided over the arrangement and conduct of the special convention trains, some of which have carried nearly 200 members and friends, hundreds of miles, and
>
> WHEREAS:—Mr. Baker in the discharge of his duties has been not only careful to secure for each member thus traveling all possible comfort, but has endeavored to enhance in every way the pleasure and lessen the fatigue of the ladies, whose attendance at these meetings has become one of their brightest and most enjoyable features,
>
> *Resolved*, therefore, that for all his characteristic kindness, courtesy and self-sacrifice in this important and responsible work as Master of Transportation, the thanks, hearty and deep-felt, of the Association be and are hereby tendered to Mr. Baker, combined with the hope that the Association may long have the good fortune to enjoy such graceful and perfect service, and
>
> *Resolved*, that these expressions of esteem and appreciation be engrossed and presented to Mr. Baker, duly signed by the officers of the Association in its name.
>
> (Signed) JAMES I. AYER.
> T. C. MARTIN.
> FREDERIC NICHOLLS.
> *Committee.*

The thanks of the Association were tendered to the several street railway and telephone companies who had extended courtesies to the delegates during their stay in Washington, and to President Armstrong, for the able and pleasant manner in which he had discharged the duties of his office during the meeting of the Association. An invitation was presented by the Georgia Electric Light Co., of Atlanta, Ga., Mutual Light and Power Co., of Montgomery, Ala., and the Anniston Gas and Light Co., Anniston, Ala., for the Association to hold its next meeting in the City of Atlanta. On motion the invitations were referred to the Executive Committee.

FRIDAY, MARCH 2.—MORNING SESSION.

The meeting was called to order by PRESIDENT ARMSTRONG at 10:30.

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[1] Owing to the delay in making the engravings accompanying Mr. Scott's paper, its publication together with the discussion thereon must be postponed until our next issue.

[2] See page 201.

The President called on Mr. L. B. Marks to open the discussion on the topic:

"ARC LIGHTS ON INCANDESCENT CIRCUITS."

Mr. L. B. Marks, before taking up the discussion of the subject announced said he desired to correct some misapprehensions which seemed to prevail on the report of Mr. Huntley's arc lamp tests at Buffalo. The impression seemed to be that the lamps tested required more energy for their efficient operation than do open air arcs. As a matter of fact the Howard bulbs do not consume more power, but on the contrary, when run at maximum efficiency can be operated at a less expenditure of energy. The machine referred to by Mr. Huntley and nominally called a sixty-five lighter was running on a circuit having considerably over ten miles of wire, in which the loss amounted to several hundred watts. Mr. Huntley stated in answer to a question at the session on Wednesday that he had been able to run fifty-five open air arcs efficiently on the sixty-five light machine whereas the same number of enclosed arcs appeared to overload the machine. He found, however, that fifty enclosed arcs could be very successfully operated and gave as good, if not better light, than the others. Thus the output of his machine was decreased by five lights. The whole question was simply one of voltage, for the enclosed arcs can be operated much more efficiently at a lower current than the open air arcs. A current of from 7 to 8 amperes answers the requirements much better than one of 9 or 10 amperes; hence though the most efficient potential difference of enclosed arc is in the neighborhood of 60 volts the actual consumption of energy when run under the proper conditions is no greater than in the open air full-arc. Moreover the machine can be so adjusted that the regulation at 8 amperes will be very efficient with the Howard system. It would be noted that whereas in open air arcs the consumption of carbon, and the consequent variation in resistance and potential difference of arc, are relatively great, such was not the case with the 100 hour enclosed arc; hence the regulation of the machine may be perfectly carried out, working at a higher point on the droop of the characteristic, reducing the current and increasing the E. M. F. Under some conditions it would be necessary to modify the machines in order to obtain the same number or a greater number of enclosed than of open air arcs on a circuit. The change was a simple and inexpensive one considering the advantages to be gained.

Coming to the subject announced, **Mr. Marks** pointed out that the record of inventions in electric arc lamps during the last few years had shown that the trend of development had been in the direction of their application to incandescent circuits. As far as the underlying principle of operation was concerned, it might be said that the various types of arc lamps for constant potential circuits were practically the same. The differences lay mainly in details. While the introduction on direct current incandescent circuits had been accomplished with a fair degree of success, the waste of a large percentage of energy in "dead" resistance was always involved; with a single arc across such a circuit, the loss of energy due to resistance in series might be from 50 to 60 per cent; with two arcs in series across the mains the loss might be reduced to about 25 per cent. On 110 or 120 volt circuits economical conditions required more than one arc lamp across the mains.

The performance of a pair of lamps connected in series on a constant potential circuit proved the conclusion which might be arrived at from a theoretical study of the conditions: First, that it is impossible to maintain a constant current through the arc branch; second, that it is necessary to insert a wasteful resistance of some magnitude in the arc branch to secure even fair results. In his admirable paper on "The Electric Arc and its Use in Lighting," read at the N. E. L. A. Convention, February, '91, Professor Elihu Thomson, alluding to the application of arc lights to constant potential circuits, had said: "A great deal of useless experimenting has been, and probably is yet, carried on with the vain endeavor of getting rid of the resistance or choking coil in this case, but the difficulty is inherent in the nature of the arc, the relation of resistance to current giving rise to instability of the current in the arc."

During the past few months Mr. C. Ransom and himself had been engaged in the development of what they believed to be an entirely new idea in arc lighting. He referred to what they have called the *high potential incandescent arc.* He had found that when the electric arc plays in an atmosphere of carbonic oxide gas, the usual relation of current, potential difference and maximum efficiency of an electrode of given diameter did not hold.

By confining the arc in a very small bulb, filled with carbonic oxide gas, they had been able to efficiently reduce the current and greatly increase the potential difference. For instance, with a pair of electrodes which in the open air arc light give a maximum efficiency at nine amperes and 50 volts, they had obtained excellent results at 4½ amperes and 100 volts, a condition impossible in open air arcs. They had no difficulty in running 100 to 120 volt arcs in this way, the current in each case being very small. The bulb used for this purpose is a modified Howard cylinder, containing a special device for controlling the inclosed gas. When operated under these conditions the arc is about half an inch long and very steady. The violet hue so common to open air long arcs is not marked, the quality of the light being especially valuable for in-door illumination. The life of a pair of 7-16 inch carbons in a 500 watt lamp is about 100 hours.

The application of this system to incandescent circuits and its advantages over the present method were apparent. It dispensed with the necessity of running two lamps in series, a single arc without appreciable dead resistance being sufficient to bridge the mains. It would be noted that the consumption of carbon is so slow that even if the points are fixed, the potential difference between the electrodes will not increase more than a few volts per hour. The comparatively rapid consumption of carbon in open air and the consequent changes in resistance and candle power of the arc, were in marked contrast to the above, and suggested an important advantage of the inclosed arc for constant potential circuits.

In the method just described the two elements whose product equals the consumption of energy in the circuit are susceptible of a wide range of variation, and may be adjusted to suit the conditions, just as the primary and secondary coils of a converter allow of great flexibility. With a potential of 115 volts between the carbon points and a current of four amperes, a single lamp consumes 480 watts on a 120 volt incandescent circuit, the amount of energy expended in the arc itself being 460 watts. The loss equals 20 watts per lamp, or 40 watts for two arcs, each directly across the mains. Comparing these figures with the data obtained from existing conditions, it would be noted that under the most favorable circumstances, the loss of energy for two open air arcs, each 460 watts, across 120 volt circuit, is 280 watts, as against 40 watts in the first case. Thus, there was a clear saving of about 20 per cent in energy accruing from the use of the high potential lamp. He would not consider the case of a single open air arc across the mains, such an arrangement being extremely wasteful of energy.

In the lamp constructed for their purpose, they have two regulating coils differentially wound on the same core, and in series relation to each other, one coil being in series with, the other in shunt around, the arc. By properly proportioning the coils they obtain a very sensitive feed. Summarizing, the advantages which may accrue from the use of the high potential lamp on incandescent circuits were as follows: (a) Saving in energy. (b) Saving in cost of trimming. (c) Saving in carbons. (d) Improvement in the quality of the light. (e) Subdivision of the light. (f) Cleanliness: no carbon dust or soot. (g) Perfect spark arrester.

Mr. W. S. Barstow, of Brooklyn, N. Y.:—As the history of low tension arc lighting began on the system of the Brooklyn Edison Co., I will simply give you as concisely as I can the advantages and disadvantages which have actually developed in commercial practice. The first disadvantages (in which we were immediately interested) were, 1. The requiring of a dead resistance in the circuit of the lamps which meant lost energy. 2. The requiring for commercial reasons of the installation of lamps in pairs.

It will not be denied probably by any one of us here that a low tension direct current system can easily manufacture current cheaper by employing large units operating in multiple than can a high tension system with its larger number of small machines. There is to day in this country a large company operating arcs on both high and low tension systems, and they have assured me, although they are wedded to neither system, that it costs them 25 per cent. less to manufacture current for their low tensions than for their high tension arcs. This is taken from actual results of the past year. With this condition before us we can easily see that we can well afford to waste 10 per cent. of energy on our low tension system outside of our station, especially when the customer pays for it. This last may make a few of you smile, but this same thing is done in high tension systems, the only difference being that in the latter the waste occurs in the station in the employing of small units, the price to the customer including this waste (which appears in the operating expenses upon which the price is based).

The question of desirability of installing lamps in pairs must be answered by the customer, and in Brooklyn the results will warrant a strong affirmative. In making a price for current for low tension arc lamps there must be taken into account the renewal of the lamp resistance, which will of course decrease in value as better methods of resistance are introduced. In order to get the same price for an arc current as for an incandescent current, which of course comes from the same generator, the price of current per 16 c. p. lamp hour was taken as a basis. It was then found that 9 cents per hour for a 1200 c. p. arc lamp current corresponded with 8 cents per hour for equivalent incandescent current, as the proportion of arc lamp renewals exceeded the incandescent. As the cost of labor in trimming an arc lamp is the same whether the lamp is burnt for one, two or six hours, it was found that in order to be fair in a meter rate a sliding scale should be used. Therefore, a scale commencing at 9 cents per lamp for the first hour and decreasing in proportion to the length of burning was adopted. It was further thought that if customers paid for current actually used without reference to the number of lamps installed and the company was to loan the lamps there would be no limit to the number of lamps asked for, while the customer would not bind himself to use all of them. This difficulty was easily settled by grading the discount price of current according to the lamp average hours per day, which was obtained by comparing the total current with the number of lamps installed. The first batch of arc lamps were installed in Brooklyn in the spring of 1890 and since then the progress has been very rapid, which can readily be seen in the fact that to-day we are operating about 2,700 lamps with orders ahead for some 400 more,—and now as to actual results.

It has been practically shown that our fears in respect to low tension arc lamps as regards the two disadvantages mentioned above were almost without actual foundation, and that we can to-day furnish lamps as cheap as our high tension competitors and still make as much profit as on our incandescent installation. The growth of the business in the face of competition I can only account for in the fact that the light is good, the control of pairs by individual switches a great advantage to the customer, as is also a meter basis for bills, while the low tension current admits of very ornamental fittings. While I am not here to boom low tension arc lamps, I can truthfully say my only regret in Brooklyn is that we have not more of them, as they have easily earned their share of our dividends.

In my hurried departure from Brooklyn, I was unable to collect what data I desired, but will submit to you a complete report on arc lamps for the year 1893, which will show more clearly the defects which we are now correcting—and almost all of these occur in the high tension system,—and as I have not accurate data on the latter I am unable to draw any comparisons but will leave that for you to do:

Number of Ward lamps in use	2,246	
Number of Bijou lamps in use	400	
Total number of complaints	3,911	
Defective carbons	2	per cent.
Retrims	7	"
Defective adjustment	12	"
Fuses and plugs blown—unknown cause	10	"
Loose connections caused by storms	6	"
Trouble with mechanism of lamp	12	"
Carbon holders broken and burnt out	1	"
Lamps grounded externally	8	"
Defective cleaning	16	"
Defective house wiring	2	"
Resistances burnt out and grounded	5	"
Defective installation	1	"
No trouble when men arrived	10	"
Special complaints	8	"
Total number of trimmers	17	
Average number of lamps per trimmer	144	
Maximum number of lamps per trimmer	170	
Maximum trims per trimmer	182	

Labor and material for repairing, repainting, rewinding resistances, and changing lamps, including testing of all new lamps,—75 cents per lamp per year.

Globe renewals exclusive of those paid for by customers—7 cents per lamp per year.

We are now working on a system of carbon renewals, which plan, though not a novel one, has not been in actual practice sufficiently long to warrant actual data. If finally successful, as there now seems no doubt of its being, it will effect a yearly saving of several hundred dollars, by enabling the company to reduce the waste of carbons caused by different rates of daily burning. Should any one desire further data in regard to low tension arc lamps on incandescent circuits, I trust they will not hesitate to call upon the Brooklyn Edison Co., who will always welcome members of the National Electric Light Association.

Mr. T. Spencer thought the great advantage in using arcs in this way was due to the fact that one class of machinery only is necessary which considerably cheapened the production of the current, and this was the principal reason why the alternating arc lamp had been introduced. The distribution of light from an alternating arc lamp could be regulated by a proper designing of the lamp. The most serious objection to the alternating lamp was the noise; but in spite of the noise he thought every central station man who had studied it had discovered that there was a wide field for it. Regarding the criticisms of foreigners on our arc lamps the principal trouble to-day was that Americans were using a carbon which no other nation would use.

Mr. Andrews of Philadelphia, said he had introduced a considerable number of arc lamps on incandescent circuits replacing arc lamps hitherto burning on the high tension circuits. He had also introduced incandescent arc lamps in places which had been hitherto illuminated with incandescent lamps, and in this way had increased the income of the station, and in a great many cases where customers who had been paying ten or fifteen dollars a month for incandescent lighting, and had constantly been grumbling about their bills, because they had not been satisfied with the quality of the light, by changing them over to incandescent arc lamps, and by increasing their bills to double, and giving them four to ten times as much light, they had paid the extra money and had been perfectly satisfied. He thought that arc lamps on the incandescent circuit would eventually supersede the high tension arc lamps, for many reasons, one of the principal reasons being that the customers wanted to be able to turn off and on their lights at pleasure, on dark days, for example, and not wait for the regular arc circuits to be turned on. He had had some experience with the Helios lamps and thought the alternating arc lamp, as a class, a great addition to the central station income. He charged by meter exclusively; he had been charging hitherto fifteen cents per thousand watt hours, and giving a varying discount, according to the size of the bills. His company trims the lamps. He agreed with Mr. Spencer's remarks regarding carbons and believed that as soon as the carbon manufacturers of this country were able to produce a carbon which would give the same effect as foreign carbons, it would give an additional impetus to the business, and it would be a great thing for central station managers. He would rather pay the same price or a little more to the home manufacturer of carbons than to go to Europe for them. (Applause.)

Mr. J. I. Ayer thought essential to emphasize this demand for a good carbon. In practice he knew that it was easier to get more money for a lamp with a first-class carbon than with ordinary carbon. It was a fact that we must get the highest grade of carbon.

Mr. Van Trump said that two years ago he decided to place arc lamps on the incandescent circuits at Wilmington; he had at that time a number of series arcs running. He had at this time 150 lamps on an incandescent circuit, and had increased the series arc business as well. He was getting a rate of 10 cents a lamp hour, about 21 cents per kilowatt hour, from his arc lamps, with a minimum charge of $2.50 per lamp per month.

Mr. Burleigh expressed surprise at Mr. Andrews' statement that he had materially increased the income of his station by using the alternating arc.

Mr. Stetson said he had installed two in a store and run them on a meter. The lamp was not satisfactory; he supposed that could be laid to the carbons; but the trouble came with the bills, and they were ordered out at the end of a trial. They were too expensive for his customers as against the regular series lamps.

Mr. Van Trump: The matter of arc lamps on incandescent circuits appears to me to solve several problems. We are now undertaking with that system work that I would hesitate to try with incandescent lamps, that is, the lighting of a large free library. We hang the lamps directly on the ceiling, burning them upside down, reversing the current, with a large reflector underneath. The light goes towards the ceiling; you cannot see the arc at all, and the room is thoroughly lighted from end to end.

The next topic taken up was

"METERS VS. FLAT RATES."

Mr. F. Nicholls: Most central stations who are using flat rates, are doing so not by choice but by force of circumstances. Companies that have commenced business on that basis have not been able to change without a loss of customers by reason of competition. In my experience nearly all companies supplying current on the flat rate principle are not furnishing lamp renewals free. In that case you will find that in nine cases out of ten the customer will purchase a low efficiency lamp and consequently the central station manager is furnishing from twenty-five to fifty per cent. more current than should be furnished if he had the right to say what kind of a lamp should be used. I know a company that I was called upon to advise with not long since, using low efficiency lamps, and carrying customers on the flat rate principle, that were furnishing 33⅓ per cent. more current that would have given the same unit of illumination if they controlled the renewals of the lamp. In the meter system, of course there is more or less conflict with customers as to the amount of current used. In this connection I wish to call attention to the fact that there is a bill pending before the Canadian Parliament for the appointment of government inspectors of meters and if there is any question between the company and the consumer as to the amount of current used the meter is to be examined and if it is found that the meter is in good working order the customer pays the cost of inspection, and if the meter is out of order the company pays it. This makes an easy method of determining these disputes which so often arise.

Mr. Scott thought it was only proper where a large quantity of water is used continuously or even occasionally that it should be measured, and the same rule would seem to apply to electricity. In dwellings it was good to have a meter but it was more satisfactory to have a flat rate for stores. We knew the hours required for lighting, the number of lamps necessary, and he had found that the merchant is usually satisfied with a fixed charge whereby he can gauge his running expenses. He had on incandescent circuit 365 contract lights and 1317 meter lights. The contract lights last year netted very much more than the meter lights.

Mr. Burleigh: I am operating two stations; one of them was formerly operated on the flat rate. We are changing that entirely to a meter rate, and in making the change have cut down our output almost one-half without materially decreasing our revenue. I regard that as a great argument in favor of meters. I believe it is the only plan, there is no other fair plan, whether it is a small customer or a large one.

Mr. Carnes: We have tried both ways, we have tried the flat way and now we are trying the meter, and recently made a rule that we will not put in a light except by a meter. I will give you one point to show how it worked with us. We had all we could do to carry what light we had to furnish; we have a capacity of 7,500 lights alternating carrying 15,000 lights wired. With the meter system we are now able to handle our costumers with perfect satisfaction.

Mr. Johns, of Cleveland: We have recently introduced the meter system in our city. We have one hotel from which we were deriving a revenue of $175 on the flat rate monthly, and from meter readings the bill was $1,100 at 16 cents a thousand watt hours; so that you can see what the meter meant in that one case.

Mr. Weeks, of Kansas City: I think no matter what the commodity is we have to sell, the only fair basis on which to sell it both for the producer and the purchaser, is a metric basis. I think the flat rate was one of the fundamental errors made by the electric light business at the outset. When our station was installed, it being the first of the kind in the world, there were no meters and for some time we hesitated and refused to install the incandescent light for that reason. We finally under pressure installed the incandescent system without service meters with the reservation that just as soon as a meter could be found we would have the right to install it. Upon that basis we undertook to give our customers a lamp for every gas jet, basing our charges upon their gas bills of the previous year. We finally got a meter to measure this service and found that we were getting pay for 32¼ per cent. of our output. We found after we adopted the metric system that we reduced our output 50 per cent. and increased our revenue.

The Convention here went into executive session. In executive session the report of the Secretary and Treasurer were read, which showed between 30 and 40 new members had been gained at this meeting.

CONVENTION NOTES.

The Souvenir of the Convention took the shape of a very pretty scarf pin in the shape of one of Gen. Washington's swords. It was of sterling silver, with the hilt finished in blue enamel. There was quite a rush for these, and no small amount of amusing intrigue and diplomacy was used to obtain them when the supply began to run short.

The Dance given at the hotel on Thursday night was a very bright and charming affair, thanks to the active supervision of Mr. C. A. Bragg, master of ceremonies. Dancing lasted for over three hours, and was very largely participated in. Few conventions have seen so many brides in attendance, and they were soon made acquainted with the fact that the Association boasts a number of talented waltzers.

The Lecture on "The Electric Lighting of the World's Fair and Some of Its Lessons," by Messrs. T. C. Martin and Luther Stieringer (consulting electrical engineer of the Fair) drew a crowded house in the Grand Army Hall on Wednesday evening. About one hundred views were shown, a large number of which were from photographs taken at night, of the fountains, search lights, cornice lighting, etc. Some of these photographs were quite remarkable. The lecturers have been collecting data and views for some time past. Special mention was made of the valuable help rendered by Mr. Oscar H. Baldwin, of the Westinghouse Electric Co., who had managed to catch some exceedingly good night pictures with his camera. It may be doubted whether so many night views of a scene have ever been presented before, but the use of non-halation plates has rendered work in this direction possible, that had not been previously contemplated.

Association Officers.—The new president of the Association, Mr. M. J. Francisco, is a member of several years' standing, the president of the Rutland, Vt., Electric Light Co., an old insurance man, and prominent for his active hostility to municipal electric plants, against which he has written and said a great deal. He will serve the Association zealously and loyally. His predecessor, Judge Armstrong, has large lighting and railway interests at Camden, N. J. Mr. Wilmerding, first vice-president, is now the confidential associate of Mr. Samuel Insull in the management of the Edison Electric Light Co., of Chicago, with special charge of the operating department. He has had a large experience in arc lighting and is now acquiring an analogous but probably a more pleasing one in incandescent work. Mr. Frederick Nicholls, second vice-president, is a man of most varied and responsible office, being a large manufacturer, the managing director of the Incandescent Light Co. of Toronto, the president of the Brantford, Can., Electric Street Railway Co.; vice-president of the Peterboro & Ashburnham Street Railway Co., and general manager of the London, Ont., lighting systems. Mr. Geo. F. Porter, the secretary, is about as efficient and energetic an officer as an Association ever had. The executive committee comprises men of prominence in the electric lighting industry, and active in the promotion of the common welfare.

EXHIBIT NOTES.

The Abendroth & Root Mfg. Co. which has been displaying so much successful energy of late in pushing its Root boiler among electric light and railway plants was represented by Mr. Maclaren, than whom no one is better acquainted with the field.

Jewell Belting Company, of Hartford, Conn., were represented by our old and true friends, C. E. Newton and C. L. Tolles. With their usual generosity on such occasions they were distributing to their numerous friends an exceptionally handsome leather card case, forming not only an ornamental, but a really useful souvenir of the Washington Convention. On this occasion they had no large belts on exhibition, but both Mr. Newton and Mr. Tolles had small samples of Jewell belting in their "inside pockets" which could be had on demand.

Doubleday, Mitchell & Co. were represented in force at the Convention, by the full strength of the firm, (except the company), both Mr. C. D. Doubleday and Mr. P. W. Mitchell being present. They were exhibiting samples of the well-known flexible conduit of the American Circular Loom Company of Boston, in sizes varying from ¼ inch to 1¼ inch inside diameter. They also showed a full line of the Doubleday-Mitchell quick break switch, in various styles, single, double and three pole, single and double throw, from 25 to 2,500 ampere capacity.

Davidson Ventilating Fan Company, of Boston, were represented by their general manager, Mr. Frank B. Parsons, of Boston. Mr. Parsons had with him several interesting models of the well-known Davidson Fan and other ventilating apparatus which he showed to many interested in this branch of electrical engineering. The Davidson Company have just recently become exclusive agents for the Meston fan motor in New England and are preparing for a large demand during the coming summer. This was Mr. Parsons' first electrical convention, but he appeared to be becoming rapidly initiated into the ways of electrical men on such occasions.

Page Belting Company, of Concord, N. H., had their New York representative, Mr. George F. Moore, on the ground looking after their interests, and giving away a large number of small booklets containing a vast amount of useful information on the subject of belting and transmission of power by belting. The book contains some good pictures of their World's Fair belts, and Mr. Moore also distributing a number of interesting souvenirs of the World's Fair which contains the now famous first representation of the St. Gaudens medal. Mr. Moore reports the order of a 48" link belt to be used for government work since his arrival in Washington, and an order of 1,000 feet for Yokohama, Japan, which orders have made him quite well pleased with himself.

The New Haven Insulated Wire Company, of New Haven, Conn., represented by Mr. C. I. Hague, showed a fan motor of new and original design. It carries a 24 inch fan, makes 720 revolutions a minute and at 110 volts consumes 1¼ amperes, exhausting about 7,500 cubic feet of air a minute. The name of the motor is the "Metropolitan," and it has a Gramme type of armature, with only one field coil, with projecting lugs encircling the armature. The commutator is on the side of the armature frame, and the motor is fitted with carbon rod brushes which are self feeding. They also showed a ¼ horse power slow speed motor, which only revolves at 600 turns per minute, and which has had a large sale, over 400 being now on order. Doubleday, Mitchell & Co. are their New York Agents.

The Standard Paint Company, of New York, manufacturers of the world-famed P. & B. paint and other specialties, were represented by Mr. Ralph L. Shainwald and Mr. Frank S. De Ronde, the latter gentleman, as usual, being loaded to the muzzle with the famous silver-lined brand of fragrant P. & B. cigars, which he presented with his inimitable grace to one and all on the slightest provocation. There was no real, live, red-headed P. & B. rooster here on this occasion, but Mr. De Ronde was quite as efficient in sounding the praises and virtues of P. & B. as a panacea for all electrical ills. Mr. De Ronde had with him also some very choice literature on the subject of P. & B., and is introducing a new tape, which will stick as long as there is any wire left for it to cling to, and which is put up for the market in such neat little boxes that one wishes to buy as soon as he sees it.

The Hart and Hegeman Manufacturing Company, of Hartford, Conn., were well represented by their popular treasurer Mr. A. H. Pease. They had an interesting exhibit of the favorite Hart snap switch in every variety, from the small 5 ampere size, up to their newest design of 50 ampere, double pole switch, which is a marvelously accurate, sure, and safe switch for its size. This switch has very heavy contact pieces and has ample ampere capacity, so that there is no opportunity for its getting out of order, sparking or getting overheated and burning up. It has a double break, quick and sure, and attracted a great deal of attention amongst the electrical contractors present. Another specialty which appeared to attract the electricians is their new flush switches, especially the lock and key switch, which cannot be operated except by possessors of keys, and is therefore incapable of being tampered with by meddlers. The flush switches have all handsome plates, finished to a high degree, with no screws in sight, and are elegant and substantial in design.

Dr. Chas. H. Bowen of Washington was there with his portable hanger for supporting cables in underground conduits.

Capt. Wm. Brophy was in attendance to represent insurance interests and to help find new definitions for "fire-proof."

The Stirling Boiler Co. was represented by Mr. Fred. A. Scheffler, not only a steam expert but one familiar with the modern branches of electric light and power from his responsible work in the factories of the Westinghouse, Brush and other companies.

The Electrical & Mechanical Engineering & Trading Co. of New York, was represented by its president, Mr. J. H. Vail, who contributed one of the most valuable and instructive papers, and had to answer a good many questions about metallic returns, rail bonds, &c.

The Carpenter Rheostats were represented by Messrs. Carpenter and Shain, while associated with them Mr. H. Ward Leonard had some very novel and ingenious forms of electric heating and soldering tools that seemed destined to begin a new era in that part of the industry.

Chas. A. Shieren & Co. were on hand with their celebrated perforated leather belting especially adapted for electric light and street railway plants. Mr. Chas. A. Schieren, Jr. and their hustling salesman, Mr. E. P. Atkinson, were in attendance as usual, also their Philadelphia representative Mr. G. H. Fisher.

The Johns Pratt Company, of Hartford, had their interests well looked after by Mr. E. B. Hatch, though their exhibit was in the charge of Mr. Henry G. Issertel of New York. No convention would be perfect without Mr. Hatch's cheerful presence, and he was at all times ready to explain the many virtues possessed by Vulcabeston and moulded mica.

Mr. Charles I. Hills, of Hartford, Conn., of "Novak" fame, was lying, a "sheer old hulk" stranded at the Ebbitt House, waiting like Micawber of old, for "something to turn up." He is an "opportunity" not to be lost on other more fortunate lamp manufacturers, who are free to sell, as "Charlie" has the reputation of being the banner lamp salesman of the country.

The National Carbon Co., of Cleveland, O., were represented by Mr. C. D. Smith, who paused for a few days in his travels to meet many of his numerous friends and talk "carbon" with them. The National Company will soon have a splendid new factory in Cleveland, which will be the finest manufactory of carbons in the country, with a very much larger capacity than their present accommodations.

The Electrical Engineering & Supply Co., of Syracuse, had an exhibit at the lower end of the red room, which was very noticeable in the way of a slate switchboard with ebonized wood frame and containing a variety of their knife switches, ammeters, voltmeters, patent concealed terminal and brackets. Their new quick break switch was also a novelty. The company was represented by their manager, Mr. H. J. Gorke, Mr. J. L. Hinds and Mr. J. D. McIntyre.

Messrs. Pass & Seymour, of Syracuse, presented a beautiful display of porcelain goods, including some new and difficult pieces which they pride themselves upon accomplishing. One was a porcelain screen, 2¼ inches in diameter, which contained 365 holes. They have a new insulating joint which is not affected by gas and has an inch insulating surface. Another special feature was their arc cut-out with porcelain case and cover. Mr. A. P. Seymour attended the exhibit each day.

The Eddy Electric Manufacturing Co., of Windsor, Conn., were represented by Mr. A. D. Newton, who favored Washington with a brief and flitting visit. Mr. Newton did not require to have any samples of their well-known type of motors and generators on exhibition, as they are so well known, but those interested in seeing Eddy machines at work in Washington, had only to step up to several of the Government buildings, where they can be seen in actual operation, doing yeoman service, year in, year out.

The Bryant Electric Manufacturing Company, of Bridgeport, Conn., were represented by Mr. W. C. Bryant, who had a very attractive exhibit set up, composed of a number of sample boards, on which were shown a full line of the well known Bryant sockets, switches, cut-outs, rosettes, etc. Some of the switches shown were of new design, and an entirely new design of the old favorite K. W. cut-out formed a special feature of the exhibit. This cut-out still maintains its well earned lead, and Mr. Bryant has recently made such changes in its design, as to enable him to put them on the market at a considerably lower price than heretofore. They showed also a new covered 500-volt cutout, which fills a long felt want, as it effectually prevents the molten metal of a blown fuse from scattering over surrounding objects to the danger of their ignition from the heat of the metal. Cleveland arc light cutouts of new and old design were also shown, the new design exhibiting many marked improvements over the old one in general, substantial features of construction and fireproof qualities.

The Electric Storage Battery Co. of Philadelphia displayed a variety of their battery plates and the merits of their celebrated chloride accumulator were set forth by Mr. J. R. Williams.

Mr. W. J. Newton was awarded the palm as the Beau Brummel of the convention. He represented the Newton Electric Co. of New York and showed samples of their cut-outs, switches, cord pendants, pole indicators, etc., of which they make a specialty.

The Columbia Rubber Works Co., of New York and Akron, O., had their trusty representative Mr. J. C. Pierrez on the ground looking after their interests and those of the Goodrich Hard Rubber Co. Mr. Pierrez had no samples in sight, but was full of information regarding all uses for hard rubber goods, not omitting the latest development in their business regarding the manufacture of the shells for telephone which they are now making and selling by the thousand.

The Vacuum Oil Co., of Rochester, N. Y., were represented by their special manager of the electrical department Mr. E. A. Record of Boston, who circulated around in his usual well lubricated manner, instilling a vast amount of useful information on the subject of oils into the ears of all consumers of this very necessary product. It matters not for what purpose one may want an oil, Mr. Record has a particular quality which will just suit and the high reputation enjoyed by his company in this field always bears him out in his statements.

The Okonite Co. was represented by Capt. W. L. Candee and Mr. G. D. Manson, with whom was associated Mr. G. W. McKinlock, of the Central Electric Co. of Chicago. As usual, the Company was rather slow to bother its friends with samples of wire and cable that had been seen before, many a time and oft, but preferred to dispense a graceful hospitality. On Wednesday evening these gentlemen took possession of a restaurant in the vicinity of the Pension Office, and there entertained a large company of friends with an oyster supper, to the pleasant accompaniment of a neat performance by the "two Boccaccios," Messrs. C. A. Bragg and Alec. Patterson.

The Carpenter Enamel Rheostat Co. exhibited for the first time an invention of H. Ward Leonard which promises to be of great importance for rheostats and electrically heated tools and utensils. On account of patents still pending the full details were not made public but the important results accomplished will be evident when it is stated that any device for the conversion of electricity into heat such as soldering irons, flat irons and certain rheostats can be constructed under the Leonard invention so that the device can, if desired, be operated continuously at a red heat or lower temperature without any destructive effect. Under the Leonard principle a No. 18 B. & S. German silver wire has been made to carry a current of 80 amperes instead of 4 amperes which would be its full current capacity if exposed to the air as usual. The Carpenter Co. is now ready to fill orders for the Leonard electric soldering iron which they are placing on the market at $5 each.

The Berlin Iron Bridge Co., of East Berlin, Conn., were represented by Mr. Burr K. Field, who secured a good position in the red room for an interesting model of their patent anti-condensation roof lining, which they have sold to so many electric light and power stations within the past year or two, and which is giving great satisfaction. The section showed the ordinary galvanized iron roof inside of which are two layers of waterproof paper, then two layers of asbestos paper, which are kept in place by a light wire netting. The iron purlins supporting the whole are 30 inches apart. No condensation can take place on the inside of such a roof, and after an experience of about two years the Berlin Iron Bridge Company recommend its adoption for all iron roofs with the utmost confidence. The waiting stand of one of the Washington street railways is equipped with this lining, as also the roof of the United States Electric Lighting Company's station in Washington.

The Hammond Cleat and Insulator Co., of Boston, were represented by Messrs. Frank W. Brigham and David J. Cartwright, and showed an extensive line of Hammond cleats, insulators, fuse rosettes, fuseless rosettes, waterproof sockets, wall receptacles, trolley guard insulators and porcelain arc light hanger-boards. Their new fuse rosette, illustrated with others of their most recent specialties in another column, is the only rosette made entirely in one piece with interchangeable fuse slide. It is absolutely waterproof and fireproof. The arc light hanger board made entirely of porcelain is new and possesses a number of important improvements over the old form of board. All the short circuit wires and connections are in plain sight on the outside, and there are no concealed parts or connections of any kind. They are also made adjustable so that one board will do for all three sizes of lamps in use, with plain lever or jack-knife switch. The trolley guard insulator is also new and is made in one piece, and can also be used as a strain insulator. All Hammond cleats can be put up with common nails, saving $3.00 to $5.00 per thousand on construction work.

The Washington Carbon Co. was represented by Mr. J. S. Crider, who was passing around sections of their new cored carbon, used for both arc and incandescent circuits; this is an article never before produced in this country.

Gen. E. S. Greeley, for once in a long while graced a convention with his smiling countenance and affable manner. As the Greeley company handle everything in the electrical supply line they did not deem it advisable to attempt to make an exhibit. Mr. Greeley, assisted by Mr. F. A. Magee, had an opportunity to shake the hand of many of their old friends and customers.

The Simplex Electrical Co., of Boston, were represented by Mr. J. H. Mason, who, while he had no exhibit, managed to find a number of friends interested in talking insulation, and extolled the particular virtues of the old standard "Simplex" wires. A convention without Simplex would seem unnatural.

The Jones Underfed Mechanical Stoker, was looked after by Messrs. F. G. Bolles & Co., of Washington, who had a number of other specialties in engines and mechanical engineering appliances, adaptable to electric light and power stations. The Jones stoker is receiving much attention from engineers at present, and bids fair to become extensively adopted in the near future.

Mr. Louis Stirn, President of the Universal Electric Pull Socket and Switch Co., New York, did not fail to attract the attention of every visitor to their novel pull sockets and switches as they passed up and down the stairs. Their sockets are adapted to all lamps and met with great favor. Mr. J. P. Freeman, the Electrical Inspector of Fire Underwriters for the District of Columbia, readily approved of both switch and socket and placed a handsome order for both with Mr. Stirn.

The Indiana Rubber & Insulated Wire Co., of Marion, Ind., had Mr. Frank W. Brigham of Boston in charge of their exhibit of wires and cables, which are all rubber covered. These samples embraced all styles, being solid, stranded or in cable form, for all capacities of light and power work. The insulation is rubber, and is double, the centre core being white, strongly braided and made for absolute safety. Large stocks of these wires are carried at 220 Devonshire street, Boston, and at 84 Frankfort street, New York, for quick shipment to all Eastern points.

The Ries Electrical Specialty Co., of Baltimore, were ably represented by Mr. Elias E. Ries, president and general manager of the company. They had on exhibition a full line of the well known Ries regulating sockets and switches which attracted considerable attention. The regulating switches are a recent production of the company and operate the same as the socket—that is, the same reaction coil within the switch regulates the degrees of light to any number of lamps from one to ten or more by a simple movement of the switch handle. The lamps are thus regulated to burn anywhere from their full brilliancy of 16 c. p. through various stages down to less than 1 c. p., after which the lamps are thrown out altogether, as in ordinary switches. These devices are intended for use instead of the regulating sockets in cases where the lamps themselves are out of reach or where a number of lamps are to be controlled simultaneously. The Ries Co., also exhibited photographs of their new Ries & Scott single and two phase alternating motors, a line of which they have in operation at their office at 7 Gay street, Baltimore.

The Buckeye Electric Co., of Cleveland, O., were represented by Mr. George R. Lean, who had with him a small portmanteau containing samples of the well known Buckeye incandescent lamps, plain, colored and frosted. Special attention was called to the 50 volt coil filament lamp, the only lamp of the kind on the market, and much interest was shown in their new non-infringing seal which is a marvelously clever device. On one of the stairs of the hotel, they showed one of their ordinary Buckeye 8½ watt lamps, and in the red room they showed their special 110 volt coil filament lamp, which is extremly small, and very well adapted for house and ship lighting. Considerable comment was made regarding the advantageous position which they occupy at present owing to the peculiar condition of incandescent lamp litigation.

Westinghouse, Church, Kerr & Co., of New York, were ably represented at the Convention by Mr. I. H. Davis, though Mr. William Lee Church put in an appearance on the last evening. Mr. Davis, besides paying considerable attention to their standard features of electrical engineering in their now well known type of "Kodak" stations, equipped with direct connected engines, mechanical draft and mechanical stokers, paid special attention to increasing the interest of central station men in their new combined ice-making and electrical plants, and succeeded in commanding a great deal of attention. Westinghouse, Church, Kerr & Co. are now recommending the adoption of ice-making as an auxiliary to electric lighting, as forty per cent. of the cost of manufacturing artificial ice is labor, and a large part of this expense is eliminated by the fact that in most central stations this labor has to be present in the day time, earning little money during the light day load. Should an ice plant be installed this labor could be turned to good account, and the product of the labor—ice—easily disposed of at a good profit.

The Electric Appliance Co., of Chicago, had Mr. F. W. Brigham at the Ebbitt House who, among a multitude of other interests, had still some time left to devote to their interests, though they made no special display.

The Chapman Valve Co., of Indian Orchard, Mass., were represented as usual by Mr. Edward L. Ross, who managed to put in some good words for Chapman valves in central stations. Mr. Ross did not require any samples of his goods with him but took pleasure in referring to the stations of the United States Electric Lighting Co., The Metropolitan Street Railway Co., and the Washington & Georgetown Railway Co., all of Washington and all of which are equipped with Chapman valves.

The Standard Underground Cable Co., of Pittsburgh, Pa., were represented by Mr. J. W. Marsh, vice-president of the company and our old friend Mr. George L. Wiley, of New York, without whom an electrical convention would indeed be incomplete. Mr. Wiley secured a pretty parlor on the first floor of the Ebbitt House, where he entertained hosts of friends, and showed a few samples of the well known Standard underground cables, particularly interesting being a few samples of the cables used in the $250,000 contract for underground feeders for the Philadelphia Traction Co., of Philadelphia, the largest contract for cables ever placed in this country.

Eureka Tempered Copper Co., of North East, Pa., were represented by Mr. John R. Coffman, who showed a full line of their specialties in tempered copper, consisting of commutator segments, for arc and incandescent dynamos and motors, commutators complete, dynamo brushes, arc and incandescent, and the Eureka gauze brush which is made up of a multitude of small wire, and has given great satisfaction, wearing perfectly smoothly, and incapable of unravelling owing to its peculiar construction. They also showed a very useful carbon brush holder for street car motors, and all kinds and sizes of sheet copper of different widths and gauges. Their new Eureka dry battery also formed an interesting feature of their exhibit.

The Helios Electric Co. of Philadelphia, were represented by Mr. Thomas Spencer, who talked about the virtues of the Helios alternating arc lamp and the Spencer economy coil. Mr. Spencer distributed much useful information regarding these specialties, drawing attention to two special features, namely, the reflecting enameled plate, by which all the light is utilized downwards, and the fact that these lamps burn with a much reduced arc, eliminating in a great measure the objectionable humming noise, common to most alternating arc lamps. The economy of the system of running these arc lamps in parallel simply, is accomplished by the Spencer economy coil which is used in connection with the lamp, which enables the Helios lamp to become a valuable and suitable lamp for inside lighting.

The Royal Arc Electric Co., of New York, were well represented by Messrs. L. E. Howard, L. B. Marks, A. H. Patterson and J. J. Gates. They exhibited two arc lamps in the main hall of the Ebbitt House, and one outside on the corner of F st. and 14th st., all equipped on the Howard system. These lamps elicited perhaps the greatest amount of attention of any exhibit at the Convention and Messrs. Howard, Marks and Gates were kept busy from early morning till late in the evening answering the multitude of questioners. The Howard device, which can be applied to any arc lamp, reduces the cost of trimming to a minimum, ordinary carbons lasting for about 60 hours, and special carbons over 200 hours. Merchants using the Howard system on their arc lamps are enabled to save a large percentage on insurance, the Board of Fire Underwriters in Hartford, where there are about 500 lamps operated on this system, having allowed the merchants in that city a reduction of 83⅓ per cent. The Royal Arc Co. are now in correspondence with electric light companies all over the Uuited States, relating to the adoption of their system.

The General Electric Company was represented by Messrs. S. Dana Greene, A. D. Page, Chas. B. Davis, T. Beran, Wilson S. Howell, A. B. Herrick, F. C. Todd, J. McGhie and one or two others, all more or less attached to the lighting and lamp departments of the General Electric business. Although its Supply Department made no special display of any of the novelties it has recently brought out, we noticed the new Thomson '93 arc lamp for incandescent circuits suspended in front of the Washington Agency, across the street from Headquarters. The simplicity of the lamp mechanism excited more than ordinary interest. The Supply Department showed also some of the new arc and railway wattmeters, constructed on lines somewhat similar to those of the well known recording wattmeters. Mr. McGhie, the company's press agent, reports that the General Electric Company is doing a really remarkable business, considering the hard times. Its Schenectady Works are swamped so far as its railway motor and generator departments, and cut-out, switch, regulator and other departments are concerned. The meter and arc lamp departments at Lynn, are both working full blast to fill the orders continually pouring in, and the Lamp Works at Harrison are, to day, many thousand lamps behind on their orders, despite their extensive facilities.

The Brush Electric Co., great progenitor of the companies that originally formed the Association, was most admirably represented by Mr. S. M. Hamill, jr. and Mr. Prentiss.

Messrs. P. J. Murphy & Co. of New York had an elaborate display of slate finished in marble, oak wood, polished black, Mexican Onyx and many other styles used for switchboards, bases and all manner of purposes where slate is required. They also had a new combination brass bolt and cap for mounting switchboards on either wood or iron frames. Mr. P. J. Murphy was present and, we hear, pocketed some fine orders.

The Baltimore & Ohio R. R. Co. deserve a word of praise as one of the most obliging and considerate railway companies that the association has ever had to deal with. It not only ran its fine special train with nearly 200 passengers over the road at a record-breaking rate of speed, but showed itself in a variety of other ways most anxious to treat the members handsomely. To deny it this brief word of praise would be sheer injustice.

The New York and Ohio Co. were represented by their secretary, Mr. W. D. Packard, and their Philadelphia agent, Mr. B. B. Downs. A display of incandescent lamps was shown in various sizes ranging from the 5 candle power baby to their mogul of 500 candle power, one of which was placed in the centre of the red room to give light for the exhibitors. The above display was also combined with that of the Packard Electric Co., who manufacture the Packard transformers.

The Pettingell-Andrews Co., of Boston, were well represented by Mr. C. B. Price, who without any samples, contented himself with circulating amongst the electrical men, and looking up the prospects of his staff in the spring for their well known specialties, paying special attention to the prospects of railway business, a branch which they have recently taken up on a larger scale. Mr. Price was well pleased with his visit and reported increasing prospects and much promise for good business in the near future.

The Mather Electric Co., of Manchester, Conn., were represented by their new vice-president Mr. T. C. Perkins, who did not bring any samples of his goods with him, but contented himself with showing his friends numerous plants in the city of Washington installed by his company, there being in fact a plant of 600 lights in the Ebbitt House, of the Mather system installed about two months ago. Mr. Perkins claims that there are more isolated Mather plants in the city of Washington than those of all the other electric companies combined. Mr. Perkins was well pleased with his trip to the Capital, and claims to have practically closed several more important contracts for large buildings in the city.

The Holtzer Cabot Electric Co., of Boston, were represented by Mr. H. E. Hall, and had their exhibit installed in the store of our well known friends, Royce & Marean, of Washington. They showed their new alternating fan motor with a 12 inch fan, of great power and capable of running at two speeds, 1500 and 2200 revolutions per minute, by means of a commutating switch at the base. This machine, unlike most other alternating fan motors, starts at once at full speed, and is not dependent upon any synchronous movement with the generator. They also showed a full line of direct current fan motors of all sizes from 110 to 500 volts. Their new ceiling fan of entirely new design, attracted a great deal of attention, as it is the only fan of this kind in the country equipped with alternating motors. The peculiar feature is that the globe supporting the fans is revolved by means of a small friction pulley on the extension of the armature shaft. The alternating type of this fan is fitted with ball bearings, runs very noiselessly, and is very economical, consuming only 70 watts.

The Phillips Insulated Wire Co., of New York, whose factory is at Pawtucket, R. I., were represented at the Convention by Messrs. H. C. Adams and A. A. Knudson. Their exhibit was composed almost exclusively of their new "Ideal" wire, and a practical test under water was shown which attracted a great deal of attention from those interested in insulation tests of wire. Two coils of wire, each about 25 feet long were shown, submerged in a basin of water, through which passed current for an incandescent lamp in the immediate vicinity. These coils have been submerged for over two months, having been put into water December 26th, 1893, at 5. P. M., and they were brought to Washington submerged in a waterproof bag. No apparent escape had yet shown itself, and the incandescent lamp burned perfectly, steadily and brightly. The insulation consists of raw cotton applied to the wire by a patented process. The method of applying the raw cotton is such that it produces an insulation apparently quite homogeneous, with very high insulating properties. It is well adapted for outside line construction, where good insulation is wanted, as it will not deteriorate like so many rubber insulations, though it is not recommended for continual submersion. It is attracting much attention amongst the trade, and is already being largely adopted especially by the telephone companies for their aerial lines where formerly rubber covered wires were used.

The Cutter Electric & Manufacturing Company, of Philadelphia, were represented by Messrs. H. B. Cutter and C. E. Bibber, who showed some very interesting and novel features in switches and lock switches. The first of these was the "Automatic," the money saver, a switch so arranged in a door lock, that when the guest of the hotel leaves his room, the locking of the door turns out the incandescent lights on the inside. Then they showed a switch for use in dark closets, safes, &c., where the closing of the door shuts off the inside light. A full line of C. S. flush commutation switches were shown, by which a lamp or circuit of lamps can be operated from three or more stations. Probably the most interesting feature of the exhibit was the C-S automatic cutout for electric cars, which effectually protects the armature, and at the same time prevents any sparking when the circuit is broken, and has none of the bad features possessed by so many other automatic cutouts for this purpose.

Mr. Henry G. Issertel, E. E., was formerly associated with the A. B. C. Company, of New York, but now occupies the unique position of electrical broker, in which capacity Mr. Issertel keeps abreast of the times in the most recent novelties, and keeps in touch with the central stations at all times, carrying the best articles at the lowest prices. On this occasion Mr. Issertel showed a very handsome board containing some beautiful samples of Iona specialties manufactured by the Iona Manufacturing Company of Boston. They make a specialty of decorative China switches for the interior of houses and the designs in general are extremely handsome. There were also shown numerous samples of the well known specialties of the H. W. Johns Company of New York, in vulcabeston and moulded mica, for electric light and railway purposes. Mr. Issertel also represents the Bernstein incandescent lamp, although there was no display made, Mr. H. B. Cram not being able to be present this year. Mr. Issertel distributed to a select few of his more intimate friends a complete box of choice "chips," with whose use some of the delegates to conventions are not totally unfamiliar.

The Interior Conduit and Insulation Co., of New York, represented by Mr. Romaine Mace, exhibited two very handsome boards fitted up with samples of interior conduit in all styles, plain, brass covered, and iron armored. The last style of conduit being their latest production, and the most perfected, attracted the greatest attention, and samples of these goods were shown from ⅜ inch inside diameter to tubes as large as 3 inches inside diameter. The conduit of their usual manufacture is inserted in ordinary wrought iron water pipe tapped at both ends, the joints being made by iron couplings, a fibre washer being inserted between the two lengths of conduit, thereby making a perfectly watertight joint. This form of conduit has specially recommended itself to architects, from its substantial nature, and from the ease with which it can be installed in buildings without the necessity of waiting for masons and plasterers, the installation of the conduit being perfectly feasible at the same time as the construction of the iron work of the building. They also showed a new conduit fitted with interchangeable safety fuses, mounted on detachable safety catches. Mr. Mace also distributed catalogues of the Interior Conduit Company's motors and dynamos, which have recently had a large sale for marine purposes. He gave away large numbers of the latest number of the admirable *Architects' Electrical Bulletin* published by the Interior company, and which was a particularly handsome and interesting issue.

The W. S. Hill Electric Co., of Boston, were well represented by Messrs. W. S. Hill and George M. Poor, who exhibited some of the handsomest and most substantial switches at the convention. The exhibit consisted of a solid polished oak table four feet square, supporting two frames set diagonally and pitched like a roof meeting at the top, on which were mounted two solid slabs of Tennessee marble carrying the switches. The exhibit was complete in every detail, the whole being shipped from Boston in parts, and set up in Washington in 85 minutes. On one side was mounted a 1,000 ampere, three pole, double throw switch, one of a lot of 185 recently made and shipped to the Philadelphia Traction Company of Philadelphia. This switch occupied the whole of one side and is of the most solid construction and handsome appearance, the brass work being finished in the highest degree, as are all the switches made by this company. On the other slab of slate, a 1,000 ampere single pole double throw switch occupied the position of honor in the centre, flanked on either side by a 100 ampere, double pole, single throw switch, one having fuse connections on the face of the slab, and the other having similar connections on the back of the slab, showing the two methods of accomplishing the same object. Above the switches were shown on one side two new closet switches, and on the other side two Hill plug locking cutouts. On the left hand upper corner was shown a switchboard rheostat and on the other corner was shown the new Doane lightning arrester, illustrated in another column of this number. Lying loose on the table was shown a section of the regular Hill arc switchboard, showing the breaking and transfer plugs. The whole exhibit was extremely handsome and appropriate and reflected great credit on the Hill Company.

Mr. C. H. McIntire was on hand with samples of the well known McIntire joints, whose use is now so universal in the various branches of the industry.

The Belknap Motor Co., of Portland, Me., were represented by Mr. Brown, who looked well after the interests of his company from down East, though he had no exhibit.

The Consolidated Electric Storage Co. of New York were on hand with a variety of storage battery plates made under the Brush and other patents. The company were ably represented by Mr. Wm. Bracken and Dr. P. G. Salom.

The Falls Rivet & Machine Co., of Cuyahoga Falls, N. Y., were represented by Mr. E. L. Babcock, who had his son with him. The many virtues possessed by the Falls Rivet clutches, were well stated by Mr. Babcock who lost no opportunity of talking with his many friends amongst central station men.

Mr. Fred. A. Duggan, proprietor of the Imperial Porcelain Works of Trenton, N. J., found business too pressing to admit of his making an exhibit at the convention. He arrived, however, on the third day with a few samples of their porcelain specialties and distributed some of their new illustrated price lists.

Mr. P. H. Alexander, of Baltimore, who has now taken up the profession of Consulting Electrical Engineer, circulated among his numerous friends in the corridors of the Ebbitt House, and renewed many friendships. Mr. Alexander was looking well, and appeared to be as well posted on current topics as ever, and talked with his usual suavity of manner and impressive effect.

Mr. W. J. Morrison was very much in evidence as usual, as representative of the Fort Wayne Electric Co., with one or two purchasers of plants, to whom he could refer inquirers as to the excellence of the apparatus. Mr. Morrison had a cheery word for the disconsolate, a bottle for the sick, and a card layout for the festive, as well as philosophical reflections for the high minded and serious remarks for the elder and the deacon. He was as ever, a convention in himself of all the amiabilities.

Mr. Frank Ridlon, of Boston, was rather unfortunate in his visit to Washington, as he was attacked with a serious sickness on the very evening of his arrival, and had to be removed to the house of some friends. He managed to recover sufficiently, however, to be able to show himself around the corridors of the hotel for one day before the Convention adjourned. Mr. Ridlon has come to be looked upon as a natural adjunct to an electrical convention, and his portly form and smiling countenance were much missed.

The Weston Electrical Instrument Co., of Newark, presented one of the most prominent exhibits in the red parlor where all their latest novelties in electrical instruments were displayed and attracted considerable attention. One of their most novel instruments shown was their new Van Vleck station ammeter and voltmeter of the edgewise pattern for central station work especially convenient where space is limited. The company were represented by Mr. Edward Weston, Prof. R. O. Heinrich and their New York selling agent Mr. Chas. D. Shain.

The Whittingham Electric Heater was shown by Messrs. E. B. Gawthrop, F. F. Della Torre, C. C. Hughes, 915 Equitable Building, Baltimore. The apparatus is very ingenious and attracted a large amount of attention. It consisted, essentially, of iron tubes encasing glass tubes with sand packing between, and a coil of wire running through the glass in suchwise that the spirals touched the glass. The ends were stoppered with lava tips. The wire was No. 22 iron, and the glass tubes were about ¼ inch in diameter. The heater and oven was built up of eight 1-inch tubes 18 inches long, while the same idea was also carried out in another form for kettle boilers, griddles, &c. The device heated up with remarkable rapidity, and was said to be very durable and economical.

The F. P. Little Electric Construction and Supply Company was represented by Mr. F. P. Little himself, the treasurer, Mr. F. W. Williams, and by Mr. J. F. Kester, the inventor of the famous "Kester" arc lamp. The exhibit of this company was in the red parlor and consisted of arc lamps for direct incandescent circuits between 50 and 120 volts, arc lamps for alternating circuits from 50 to 100 volts, besides lamps for constant current circuits of from 6 to 10 amperes. The company also showed a line of single and double throw knife switches for station use. It had also on exhibition some Kester commutator compound which is fast becoming popular for dynamo and motor commutators. The arc lamp which was burning so beautifully in the red parlor during the Convention, was a "Kester" constant potential lamp, running from a 110 volt circuit. This lamp will feed within 3 volts. From time to time Mr. Kester placed globes of different descriptions on his lamp and illustrated how expeditiously this change could be made. Mr. Little naturally feels good over the fact that by the third day of the Convention he had taken actual orders for more than 70 of these "Kester" arc lamps, to be delivered at once. After the Convention Mr. Little left for Asheville, N. C., where he intends to take a much needed vacation.

The Chas. Munson Belting Co. were represented by their president, Mr. A. Groetzinger and their Chicago representative Col. J. H. Shay.

Mr. Felix Haac, of the American Silk Mfg. Co., Philadelphia, presented a few samples of their patent silk machine wipers. They are said to be economical, safe and practical.

Messrs. Diehl & Co., of New York, were represented through their Washington agents, Messrs. Jordan & McLeod. They had on exhibition one of their most recent inventions—a combination electric fan and electrolier, containing six incandescent lamps so arranged that one or all can be used, the lights and fans being independent of each other.

Mr. John McLeer, the electrician of the Camden & Amboy division of the Pennsylvania R. R., was one of the most intelligent and quietly observant visitors to the convention. His presence may well be regarded as a sign of the manner in which electricity now touches the largest and most varied interests and is watched by their progressive officials.

The General Incandescent Arc Light Co. had several of its handsome lamps in service in the hotel. Its two-light chandelier on the second floor was a beauty and attracted considerable attention. Both alternating and constant current lamps of their most attractive patterns were scattered about the building. Mr. S. A. Douglass assisted by Mr. E. Lavens and Mr. G. Kirkegaard was kept busy showing their lamps to visitors.

Royce & Marean, represent to many electrical people the central, permanent point of interest in Washington, and their store adjoining the Convention Hall was a great rendezvous during the week. Mr. Royce was more attentive and obliging than ever, and was asked in return to take up half a dozen new agencies. Should he do so, it is his intention to issue shortly another edition de luxe of his beautiful and copious catalogue.

The Columbia Incandescent Lamp Co., of St. Louis, was represented by President J. H. Rhotehamel, who thus had the pleasure of meeting a good many customers and of repeating to several inquirers his statement that he intended to carry out to the end his hitherto successful legal fight, and that all purchasers would be protected and guaranteed by his company. Mr. Rhotehamel indicated some interesting new ideas and lines of development.

The Crocker-Wheeler Electric Co. were well represented by Dr. S. S. Wheeler, Mr. H. L. Lufkin and a beautiful new armature. The store of Royce & Marean was frequently visited by those who wished to examine the armature, which weighed 540 pounds, and was built up entirely without wire and without solder, and finished in the highest possible style of the motor-making art. The company has lately been invited into a number of new fields of motor design and application and is again busy with wonted orders from central stations.

Mr. W. Forman Collins, the business manager of the *Western Electrician*, deserved a better fate than attended him. It was his first convention as one of the proprietors of that journal, and he had made the trip from Chicago in spite of sickness. Arrived in Washington he had to succumb to pain and fatigue, and although he struggled bravely into his clothes once or twice, the larger part of the week was spent in bed. He received a great many callers and sympathizers in his room, and heard many regrets at his enforced absence from the convention hall.

The Norwich Insulated Wire Co. was represented by Mr. Geo. J. Jackson, who showed with pardonable pride the latest product of the Company's works. This consists of a three conductor cable intended for an alternating 3-wire circuit and weighing 15 lbs. to the foot complete, while the copper alone weighs 9 lbs. per foot. The cable is built up of a central stranded core insulated with the company's paper insulation and having laid about its circumference the two outside conductors, the combined conductors having an area of 3,000,000 circular mils. The cable is enclosed in wrought iron or lead pipe. The exhibit also included a display of 105 different samples of wires and cable made by the company, from No. 22 to 3,000,000 circular mils area.

The Love Conduit Railway System which has been fully and frequently described in these pages was inspected by a great many delegates, under the guidance of the electrical engineer of the road upon which it is used, Mr. M. D. Law, one of the oldest members of the association. One of the editors of the **Engineer** visited it immediately after the extremely heavy snowstorm of Sunday and Monday, and found it in admirable operation, although at one end water was pouring into it from melting snow banks just as though it were a tank. The general impression among the delegates was that it showed conduit roads to be entirely and commercially operative. As one of the best known engineers in the field put it: "This road is just as far along as was Frank Sprague's pioneer road at Richmond, and it will be just as much a historical starting point." Mr. Law deserves much praise for the work he has done in developing and perfecting Col. Love's ideas.

Mr. C. S. Van Nuis traveled around with a miniature "Ajax" switch in his pocket.

The New York Insulated Wire Co., were represented by Mr. Frank Harrington.

The LaRoche Electrical Works were represented by Mr. Frank R. Ford. It had been the intention of Mr. Fred. A. LaRoche to attend but very important business called him away in another direction.

The Donaldson-McRae Storage Battery was shown in one of the parlors, and exemplified a practical type now in large use in Washington, Baltimore, etc. They were represented by Mr. W. W. Donaldson and Mr. Smith.

The Westinghouse Electric & Mfg. Co. were represented by Messrs. Baldwin, Stilwell, Townley, Bragg, Scott and Heinrichs. A neat pamphlet was distributed, on the merits of the Westinghouse series direct current arc lighting system.

Mr. J. A. Pentz of Philadelphia showed a most ingenious and novel form of storage battery plate of the Planté type, produced in a manner new to the art and permitting a very rapid formation of the cell, as well as of enormous capacity. Details may be looked for at an early date.

The Electric Construction and Supply Co., represented by Mr. R. B. Corey, had been preparing a fine exhibit of its arc lamps on incandescent circuits in Washington for some time past, and the result was that delegates found hundreds of these lamps in choice positions all over the city.

The American Electric Mfg. Co., of St. Louis had no exhibit at the convention but were ably represented by Mr. Louis Nahm, who distributed a very choice little souvenir in the shape of an American lamp resembling a balloon, with rigging and basket attached. It is at once pretty and ingenious.

The Sunbeam Lamp Co., was represented by Mr. F. S. Terry, to whom an electric light convention is but a gathering of old friends and acquaintances not a few of whom hastened to extend him their warm and hearty wishes for a new career of larger prosperity, under the changed conditions. Few men in the field present so strong a combination as does Mr. Terry, of youth, energy and experience, all of which will again find their opportunity in better times.

Queen & Co., Incorporated, of Philadelphia, attracted great attention with their display of "Acme" hot-wire voltmeters, portable, switchboard and recording types, as also "Acme" portable testing sets, cable testing apparatus, etc. The "Acme" voltmeters are extremely compact and well made. They are accurate alike for alternating and direct circuits and are dead beat, without the use of a mechanical brake—this latter feature being possessed by no other standard alternating current voltmeters. A neatly prepared price list was distributed, which gave full particulars as to ranges, styles of mounting and prices. Instruments are supplied with single or double scales and with multipliers of any desired capacity up to 5,000 volts. Next to refined accuracy the most important fact about the "Acme" voltmeters is the remarkably low prices at which they are offered, thus making it possible for every plant, however small, to have strictly reliable testing instruments. The "Acme" Portable Testing Set, samples of which were displayed, is the multum in parvo of a resistance measuring instrument, as it contains Wheatstone bridge, rheostat. D'Arsonval galvanometer and silver chloride battery—all in a highly finished mahogany case 8¼" x 5¾" x 5". It has a capacity of several megohms and in addition to insulation tests is well suited to determining the resistance of dynamos, motors, lamp filaments and for general laboratory measurements. The Queen exhibit was in charge of Mr. J. G. Biddle, manager of Electrical Department, and Mr. E. G. Willyoung, electrical expert.

LETTERS TO THE EDITOR.

THE GIBBS-BRACKEN STORAGE BATTERY CONTROVERSY.

In stating to the public our position in respect to the unwarranted statements and claims made by the Consolidated Electric Storage Company as to our infringement of the Brush patents, it was not my intention to enter into a newspaper controversy with Mr. Bracken, but in view of his attempted reply, I desire to state further:

First. He states:

> "We disclaim Mr. Gibbs' charge of the circulation of any objectionable matter in relation to his battery, except that in one or two instances we have sent to purchasers the usual notice of infringement."

The following is a copy of letter written to the Provident Life & Trust Company of Philadelphia (one of our most prominent financial institutions) accompanying the "usual notice of infringement." Please note the date: December 8, 1892:

> "Office of Consolidated Electric Storage Company,
> 926 Drexel Building, Philadelphia,
> December 3, 1892.
>
> Samuel R. Shipley, Esq., President,
> The Provident Life & Trust Company, Phila., Pa.
>
> Dear Sir:—
>
> In passing by the Provident Building yesterday I noticed that you were receiving a number of electrical accumulators or storage batteries, presumably for the purpose of electric lighting. These batteries we understand were made at Gloucester, N. J., and are a most flagrant infringement of the Brush patents controlled by this company.
>
> In view of the repeated warnings you have had from this company, in shape of circular letters advising you of the scope and validity of our patents, it is difficult for us to understand why a reputable concern will deliberately violate the adjudicated rights of this company.
>
> We therefore warn you again to desist from installing and using these batteries or we shall be compelled to enter suit against you for infringing our patents. We enclose circulars relating to the same, in case they may not have been brought to your personal attention and if you will consult your attorney about the matter, he will certainly advise you to respect our rights. Yours truly,
>
> The Consolidated Electric Storage Company,
> Pedro G. Salom, Secretary."

The installation referred to was put in at that time and has been in continuous and successful operation up to the present time, and no suit was instituted.

This is the character of communications and statements that they have continued to make. We leave it to the public to judge of whether they are objectionable in view of the fact that no court has determined the Chloride Battery to be an infringement of the Brush or any other patents.

In the second place, Mr. Bracken states that the Société Anonyme pour le Travail Electrique des Métaux, of Paris, manufacturers of the Chloride Battery in France, was sued last year by the company owning the French Faure patent, and that Baron Rothschild, who is largely interested in the Chloride Battery Company, purchased peace at the expense, as he is informed, of several hundred thousand dollars.

This I state to be unqualifiedly false, and it seems remarkable that Mr. Bracken would make a statement the correctness of which can be determined by the records, without ascertaining as to its truth or falsity.

The facts are that the Société Francaise of Paris, controlling the Faure-Sellon-Volckmar patents (which are patents covering the ordinary pasted or red-lead plate batteries) brought suit against one Pollak, who manufactured a battery having a lead support or base with finely divided elongations in which the active material was pasted and pressed, the variation from the Faure patents being only in the particular method by which the active material was mechanically applied. This case was tried. The District Court, on the testimony of the experts, decided in favor of Pollak. This was appealed and the higher court reversed the decisions. This placed the Société Francaise in a position where their patents in France practically controlled all the pasted or red lead accumulators.

As there were a large number of manufacturers in France, as there are in this country, making these inferior types of battery, through the defects and failure of which the accumulator business has been so greatly discredited and demoralized, the company owning the Chloride battery, controlled by the Rothschilds, concluded that the purchase of these patents for a nominal consideration would be the best means during their unexpired term of about two years, of removing from the accumulator field these inferior types of battery, which, notwithstanding fourteen years of failure, still continued to claim merit, and made it all the more difficult to convince purchasers that a new principle had been discovered by which a reliable and commercially successful accumulator could be produced. It was for that purpose, and that purpose only, they purchased these patents. No suit was ever instituted under the Faure patents against the Society controlling the Chloride Accumulator in France. I therefore leave it for the public to judge whether any further statements that Mr. Bracken may make in defense of his position are worthy of consideration.

In view of the foregoing, I need hardly add that it is not incumbent upon me to defend Professors Chandler and Barker against any statements of Mr. Bracken.

W. W. Gibbs, Prest.,
Electric Storage Battery Co.,
Drexel Building, Philadelphia.

Philadelphia, Pa., March 2, 1894.

Mr. W. W. Hess, formerly representative of the Car Publishing Co., of Philadelphia, has resigned his position with that publication to accept one as general manager of the Car Equipment Company, of Philadelphia, with offices at 741 Drexel Building. This company will be exclusive agents for the Graham truck and Ajax metal for electrical purposes in the middle states and Ohio and the southern Atlantic states and will handle the product of the Allen Electric & Supply Co., Mr. Wm. A. Barrett, jr., is their president. Mr. Hess has a large acquaintance in the street railway field and no doubt will be as successful in his new venture as he has been in the past.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF ELECTRICAL PATENTS ISSUED FEBRUARY 20, 1894.

Alarms and Signals :—

Electric Bell Alarm, W. H. Orpen, Jr., Brooklyn, N. Y., 514,960. Filed Apl. 29, 1891.

Electrical Annunciator, N. M. Watson, Detroit, Mich., 514,975. Filed July 7, 1892.

Electric Signaling Between Railway Trains, J. J. Czepull, Lancaster Pa., 515,145. Filed Aug. 8, 1893.

An automatic electric block system giving a signal within the cab of the locomotive.

Conductors, Conduits and Insulators :—

Electric Cable, T. Guilleaume, Mulheim-on-the-Rhine, Germany, 514,925. Filed Oct. 6, 1893.

Consists of a body of grooved insulating material with electrical conductors lying in the groove.

Material for Insulating Electric Wires, G. A. Cannot, London, Eng., 515,192. Filed Sept. 22, 1893.

Consists of bitumen, peat fibre, spermaceti and tar.

Distribution :—

Transformer, F. S. Hunting, Fort Wayne, Ind., 514,933. Filed Feb. 25, 1892.

Has for its object to produce one or more independent currents of differing phase from two or more alternating currents of differing phase.

Electrical Converter, A. L Riker, New York, 515,020. Filed July 27, 1893.

Relates to the form of the stampings used for building up the converter core.

Electric Distribution Box, O. D. and M. A. Kleinsteuber, Milwaukee, Wis., 515,087. Filed June 27, 1893.

Relates to certain details of coustruction in distribution boxes for underground cables.

Dynamos and Motors :—

Alternating Current Motor, C. S. Bradley, Avon, N. Y., 514,902. Filed Sept. 27, 1892.

Employs two secondary elements, one of high and the other of low resistance and means for shifting them so that a single primary element may co-operate with either secondary.

Alternating Current Electric Motor, C. S. Bradley, Avon, N. Y., 514,903. Filed Sept. 27, 1892.

Has one element wound to develop progressively shifting magnetic poles and the other provided with a closed secondary circuit inductively related to the shifting poles.

Alternating Current Motor, C. S. Bradley, Avon, N. Y., 514,904. Filed Jan. 14, 1893.

Has two armature circuits one of which is an inductive circuit continually closed upon itself, while the other is connected with the source of supply through a re-directing commutator producing constant polarization of the armature core at synchronous speed.

Dynamo Electric Machine, C. F. Brush, Cleveland, O., 514,907. Filed Jan. 14, 1879.

Claim 2 follows :

An alternating current generator comprising two series of field magnets, coreless coils or folds mounted on a diamagnetic carrier, and a shaft having insulating material interposed between its sections.

Dynamo or Electric Motor, L. Gutmann, Pittsburgh, Pa., 515,216. Filed Feb. 13, 1892.

Employs field magnets arranged in two parallel core structures and armature cores rotating between the latter (See THE ELECTRICAL ENGINEER, Feb. 21, 1894.)

Galvanic and Thermo-Electric Batteries :—

Battery, D. H. Wilson, Chicago, Ill., 514,979. Filed Sept. 8, 1893.

Claim 1 follows :—

In a primary battery the combination of zinc and copper plate with their broad surfaces exposed to each other, their exposed sides deeply corrugated, and a solution in which said plates are immersed.

Lamps and Appurtenances :—

Electric Arc Lamp, S. W. Rushmore, Brooklyn, N. Y., 515,022. Filed Feb. 20, 1893.

Employs a single electro-magnet in combination with an armature moving upon a central axis under the influence of both poles of the magnet, and a short train of gearing mounted in a frame pivoted upon an axis coincident with that of the armature.

Arc Lamp, W. O. Meissner, Chicago, Ill., 515,125. Filed Sept. 11, 1893.

Employs a clutch adapted to move the carbon rod in either direction and an electro-magnet controlling the clutch.

Electric Arc Lamp, B. Ford, Johnstown, Pa., 515,205. Filed Dec. 8, 1892.

Relates to certain modifications of the clutching mechanism.

Measurement :—

Electrical Meter, N. Tesla, New York, 514,973. Filed Dec. 15, 1893.

Consists in maintaining by an alternating current a high tension discharge through a rarefied gas between two conductors and computing the energy expended by the amount of material thrown off from the conductors by the action of the discharge.

Miscellaneous :—

Switchboard System, D. H. Wilson, Chicago, Ill., 514,980. Filed Sept. 8, 1893.

Designed for use in connection with an "electric fence" system, *i. e.*, a metallic fence so arranged that an animal coming in contact therewith will receive a shock through its body.

Circuit Making and Breaking Device, D. H. Wilson, Chicago, Ill., 514,981. Filed Sept. 8, 1893.

Relates to automatically operated circuit closers for induction coils.

Electric Elevator Brake, A. J. Shaw, Muskegon, Mich., 515,255. Filed Oct. 24, 1893.

Electric Elevator Brake, A. J. Shaw, Muskegon, Mich., 515,256. Filed Nov. 4, 1893.

Electric Elevator Brake, G. A. Brown, Muskegon, Mich., 515,281. Filed Oct. 18, 1893.

Electric Steering Gear, F. L. Dyer, Washington, D. C., 515,286. Filed April 17, 1893.

Electric Igniter for Gas Engines, J. Low and J. W. Gow, Steubenville, Ohio, 515,297. Filed May 13, 1893.

Metal Working :—

Process of Coating Metals with Oxides, C. R. Arnold, Sharon Hill, Pa., 514,896. Filed Apl. 29, 1893.

Railways and Appliances :—

Trolley Wire Support, R. M. Hunter, Philadelphia, Pa., 514,962. Filed June 30, 1893.

Employs a supporting structure arranged upon the under side of the trolley wire and attached to the span wire.

Electric Railway System, N. Tesla, New York, 514,972. Filed Jan. 2, 1892.

Claim 1 follows :

In an electric railroad system operated by electric currents of high potential and frequency, the combination of an insulated and electrically screened supplying conductor extending along the line of travel, a motor car or cars carrying a conductor plate or bar in inductive relation to the screened conductor and an electrical connection between the said plate and the motor.

Electric Railway Conduit, M. S. Towson, Cleveland, O., 515,179. Filed Jan. 6, 1893.

Claim 1 follows :

The combination with a slot rail of a conductor, suspended from said slot rail by fastenings passing through the foot of the rail.

Trolley Conductor and Support, M. D. Law, Washington, D. C., 515,238. Filed Aug. 29, 1893.

Especially designed for use in connection with the Love conduit system. (See THE ELECTRICAL ENGINEER, Feb. 28, 1894.)

Indicator for Electric Cars, H. C. Beckmann, St. Louis, Mo., 515,274. Filed Aug. 17, 1893.

An electric station indicator actuated by current from the trolley wire.

Electric Railway Trolley, C. J. Van Depoele, dec'd., Lynn, Mass., 515,306. Filed June 18, 1888.

An under running trolley on a pivoted support.

Switches and Cut-Outs :—

Rheostat, J. B. Lyon, Brooklyn, N. Y., 515,241. Filed Dec. 22, 1891.

Claim 1 follows :—

A rheostat consisting of the combination of a resistance medium and a pair of electrodes geared together and movable with respect to each other.

Rheostat, A. J. Shaw, Muskegon, Mich., 515,251. Filed Oct. 13, 1893.

An open frame with a wire wound about it and connected with it at one end but insulated from it at all other points.

Rheostat, G. A. Brown, Muskegon, Mich., 514,280. Filed Aug. 19, 1893.

Claim 1 follows :—

A resistance card or body composed of a strip or band of metal folded back and forth upon itself,—the folds being separated only by the scale of oxide formed upon their faces.

Rheostat, A. J. Shaw, Muskegon. Mich., 515.304. Filed Oct. 13, 1893.

Consists of a band wound in a flat spiral whose convolutions are separated by a layer of enamel.

Telephones and Apparatus :—

Cushion for Telephone Receivers, V. A. Cook, Averill Park, N. Y., 514,913. Filed Nov. 28, 1893.

A pneumatic annular cushion adapted to be fastened upon the face of the receiver. (See THE ELECTRICAL ENGINEER, Feb. 28, 1894.)

Telephone, D. Drawbaugh, Eberly's Mill, Pa., 514,916. Filed July 26, 1880.

Employs a diaphragm carrying two electrodes insulated from each other, and an opposing electrode held against the former electrodes by an electric pressure device.

Telephone Transmitter, P. Fitzsimons, Birmingham, Ala., 514,920. Filed June 14, 1893.

Relates especially to the arrangement of the vibratory elements and their connections and to the employment of a non-vibratory support.

Electrical Circuit Controller, R. Callender, Brantford, Can., 515,108 Filed Nov. 2, 1893.

Employs a series of radically disposed plungers adapted to be moved into electrical connection with a common conductor, and a revolving arm carrying an electro-magnet for actuating the plungers.

Electrical Circuit Controller, R. Callender, Brantford, Can , 515,109. Filed Nov. 2, 1893.

Employs two or more vibratory reed armatures actuated by a controlling electro-magnet, and means whereby two or more local circuits are independently controlled by the reed armatures at the termination of their individual vibratory periods.

Automatic Signaling Transmitter, R. Callender, Brantford, Can., 515,110. Filed Nov. 2, 1893.

Employs a controlling commutator and a rotary circuit making and breaking device timed to have a definite relative speed of rotation; means for giving the circuit closer any number of revolutions, and for varying the number of closers in each revolution

THE OHIO BRASS COMPANY.

THE OHIO BRASS COMPANY, of Mansfield, Ohio, have just issued a well printed and well filled 84 page catalogue describing and illustrating about 250 of the electric street railway specialties of their manufacture. The company's devices are all thoroughly tested for electrical and mechanical defects, and are approved by their engineering department before being sent out.

The tendency of the times is to specialize on one line of work, and the Ohio company have recognized this fact in confining themselves to the street railway field exclusively, realizing that a greater degree of perfection in the manufacture of goods, can be arrived at in this manner. Their facilities for the manufacture of special devices, are unexcelled, and although heretofore they have not been brought directly into contact with those who purchase for the street railway companies, yet they have been manufacturing construction material during the past few years for one of the largest supply companies in the West, and their products are now in use on many of the largest roads in the country.

The catalogue is well arranged and is furnished with a good index.

The R. Thomas & Sons Company, of East Liverpool, Ohio, manufacturers of hard vitrious porcelain electrical supplies, have issued their catalogue, No. 3, containing 36 pages of beautiful full size reproductions of their specialties in white against a solid dark bronze background. No text is given, as the illustrations are so perfect that none is required, and the insulators, fuse blocks, rosettes and what not stand out so boldly that one is tempted to use them as they are instead of ordering real ones from the makers. In order to provide for the latter alternative, however, the company have offices at 136 Liberty street, this city, and 115 Dearborn street, Chicago, in addition to their general office and works at East Liverpool, Ohio.

Trade Notes and Novelties

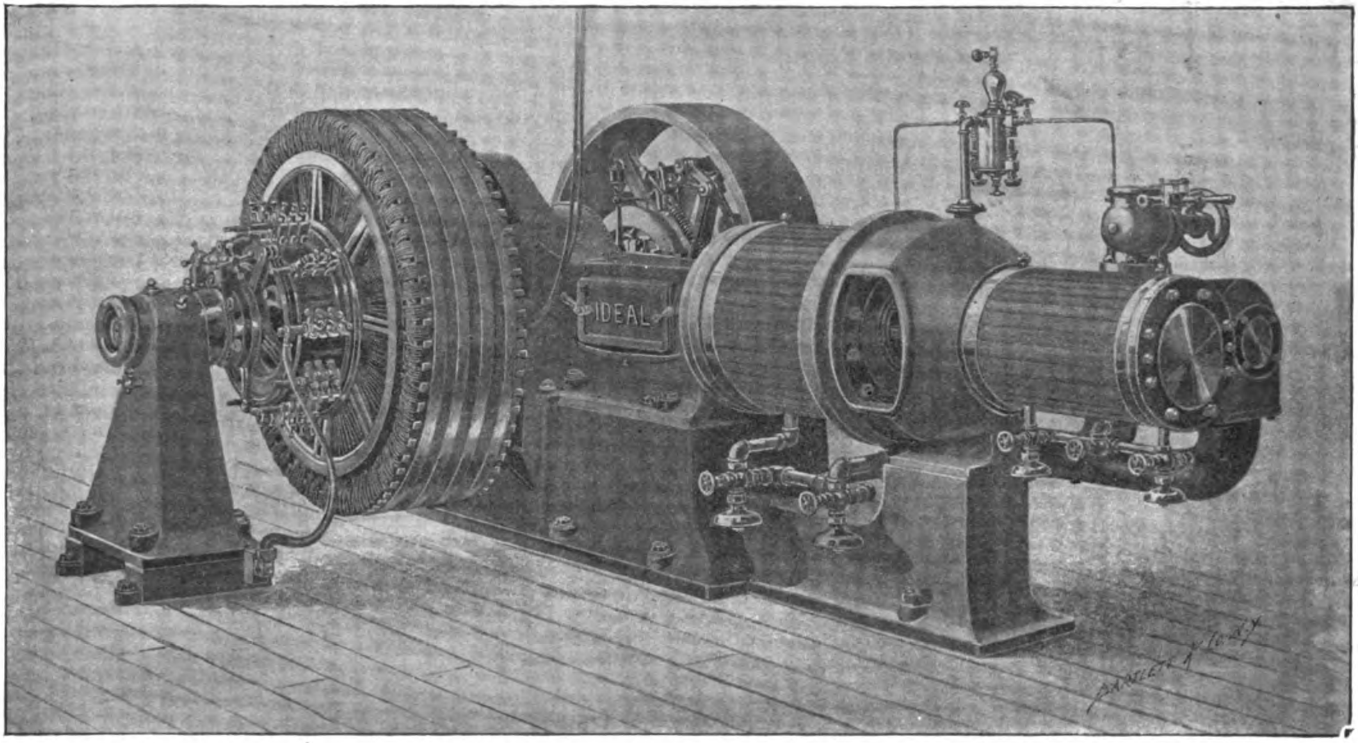
AND MECHANICAL DEPARTMENT.

DIRECT CONNECTED "IDEAL" ENGINES.

The direct connected combination of engine and dynamo of to-day is demonstrating by an increasing number of plants, its practicability, efficiency, and sound principles. The accompanying illustration shows perhaps the most modern of these combinations yet produced. This comprises a multipolar dynamo of the Waddell-Entz type, driven by a Harrisburg tandem compound Ideal self-oiling engine. The dynamo is 80 k. w. capacity and the engine cylinders are 10 and 17 inches in diameter by 12 inches stroke built in this instance for running non-condensing. The speed of the combination is 260 r. p. m. under a pressure of 115 to 125 lbs.

The Ideal engine as now manufactured has several important improvements. The self-oiling feature is a highly efficient device, supplying all the bearing surfaces with continuous streams of oil. Perfect circulation of oil is thus had without the care and attention dependent on drop feed or other oiling devices. The important bearing surfaces are dust-proof, and there is freedom from all splashing and dripping of oil. In direct connected work of this character, it is extremely important that the dynamos should be kept as free from oil as possible, as short circuits are often traced to the neglecting of this precaution. The remarkable simplicity and strength of the machine will be noticed, and the method of support under the cylinders is considered especially good by the makers. With this combination a water consumption is claimed in service of 23 pounds per h. p. non-condensing.

The engine shown is the product of the Harrisburg Foundry and Machine Works, of Harrisburg, Penna., and was ordered and installed at the Bridgeport Copper Company's Works by their representatives for New York and Boston, W. R. Fleming & Co., 203 Broadway, New York, and 620 Atlantic Ave., Boston.



HARRISBURG IDEAL ENGINE AND WADDELL-ENTZ GENERATOR.

THE "STRAIGHT LINE" centrifugal separator and grease extractor is one of the most popular devices of the kind now upon the market. It is used by a large number of electric light and power stations, railroads, and manufacturing plants generally, Joseph De Rycke, sole manufacturer, reports a brisk trade.

SAMSON ARC-LIGHT TROLLEY AND ARMOR CORD.

The Samson Cordage Works, of 115 Congress street, Boston, write that Samson braided cord has now become the standard for the suspension of arc lamps, and is no less in demand for street car trolley cord, and armor cord for covering field magnets of dynamos. The size most frequently used for hanging arc lamps is No. 12 (⅜-inch diameter); for trolley cord No. 8 (¼-inch diameter), and for armor cord, No. 4 (⅛-inch diameter). Unless otherwise ordered, the waterproofed finish is always applied to the arc-lamp cord and the trolley cord, and they are put up in coils of about 1,000 feet each.

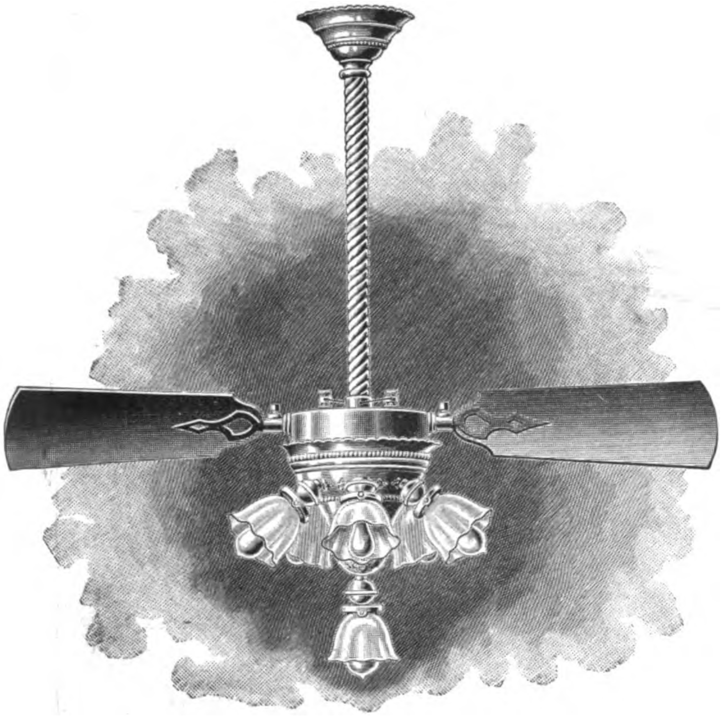
When desired, the company furnish their "Samson Spot Cord" which is the same quality and price as the plain Samson cord but marked with a succession of spots of a different color from the body of the cord. This device is trade-marked, and is for the purpose of identifying at sight the first quality cord. There is now on the market, it is said, a quantity of low grade braided cord which does not possess the strength or durability which is requisite for these purposes. All Samson cord is warranted of pure stock, perfect braid, and to be entirely free from waste stock, and purchasers may have confidence that the "spot" is a guarantee of quality.

MR. EDWARD M. BENTLEY, formerly the inventor and engineer of the Bentley-Knight Electric Railway Company, who has been for the past four years and a half in charge of the Patent Department of the Thomson-Houston Electric Company and the General Electric Company, has severed his connection with the latter company and opened an office at 40 Water street, Boston, taking up the work of expert in patent cases and solicitor of patents. The law firm of Bentley & Blodgett with which Mr. Bentley, who is a member of the bar as well as an expert, has been connected, will be dissolved, and his former partner, Mr. G. R. Blodgett, will succeed him as head of the Patent Department of the General Electric Company, making his headquarters at Schenectady.

THE roof for the new electric light station for the Citizens' Electric Light, Heat & Power Co., at Lancaster, Pa., is to be furnished by The Berlin Iron Bridge Co., of East Berlin, Conn.

THE DIEHL ELECTROLIER FAN.

Messrs. Diehl & Co., of 385 Broadway, are placing upon the market for the coming season a novel device; an electrolier-fan, combining the two. As shown in the illustration it is handsomely designed and finished, and both fan and lights can be operated independently or together, as desired. The Diehl apparatus is already so well known that no further description is necessary in regard to this combination, which will doubtless become popular as soon as the warm weather sets in.



Diehl Electrolier Fan.

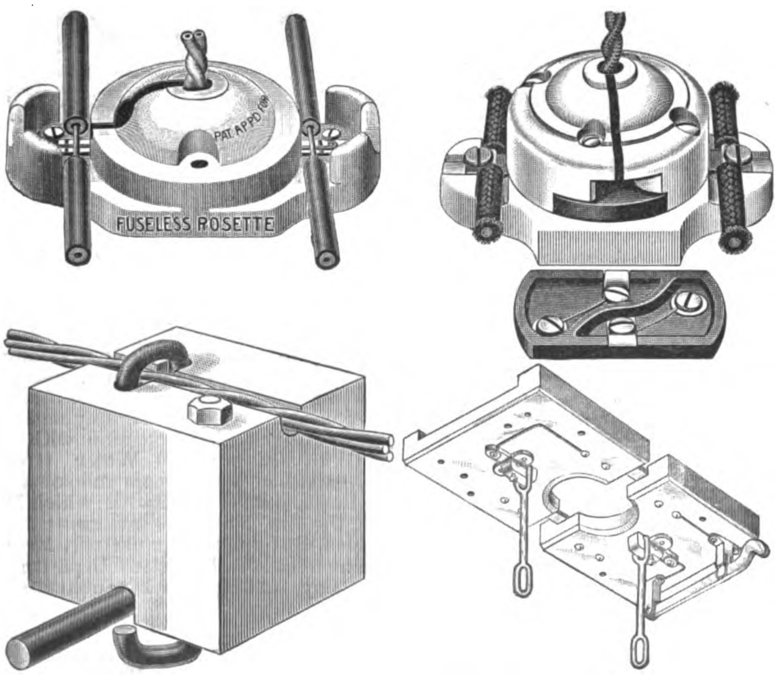
SOME NEW HAMMOND SPECIALTIES.

The Hammond Cleat & Insulator Co., of 15 Custom House street, Boston, have recently brought out several interesting specialties in porcelain insulators, rosettes, etc., some of the more noticeable of which are shown in the accompanying illustrations.

Fig. 1 shows the fuseless rosette made in one piece with a solid back, and therefore perfectly fire and waterproof. The cord is easily attached and there are only two screws in the entire device. The double pole fused rosette, Fig. 2, has its cover and base in one piece and hence affords no chance for a loose contact, while, like the fuseless rosette, it is water and fireproof. It can be used for moulded or cleated work. The fuses, as will be seen, are attached to an interchangeable slide, independent of other connections. These slides may be kept, ready fused, for emergencies.

Fig. 3 shows the trolley guard insulator made of one piece of porcelain japanned black. It is so constructed that the slipping of the guard wire or span wire is impossible. It is easily attached and has no parts to loosen or drop, and can also be used as a strain insulator.

The adjustable arc light hanger board, Fig. 4, is said to be the only one which conforms to the rules of the Insurance Exchange. Being constructed entirely of porcelain and metal, it is moisture and fireproof, with all electrical parts in plain sight, and no concealed wires anywhere. This hanger board can be used on high or low potential circuits. For the former it is provided with a jack knife switch. It is furnished in two sizes, the distance between lamp contact terminals being adjustable from 5 to 8 inches, and from 9 to 12 inches, respectively.



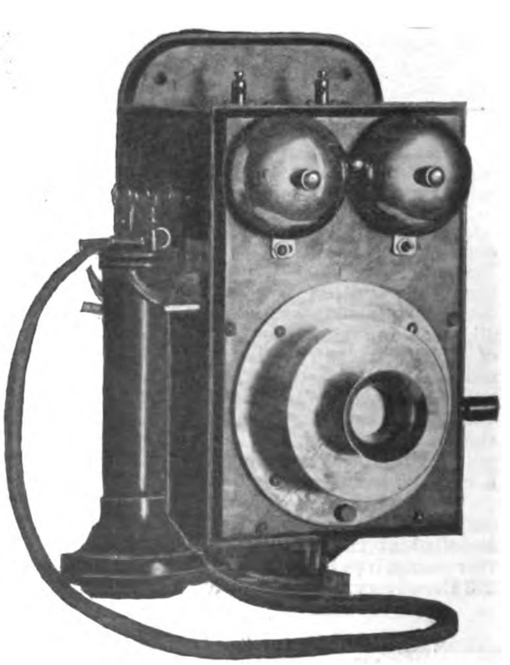
Figs. 1, 2, 3 and 4.—Hammond Rosettes, Insulator and Hanger Board.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY'S APPARATUS.

Among the telephones placed upon the market since the expiration of the Bell receiver patent, the standard instrument of the Western Telephone Construction Company, Chicago, bids fair to take a prominent position among instruments of that kind.

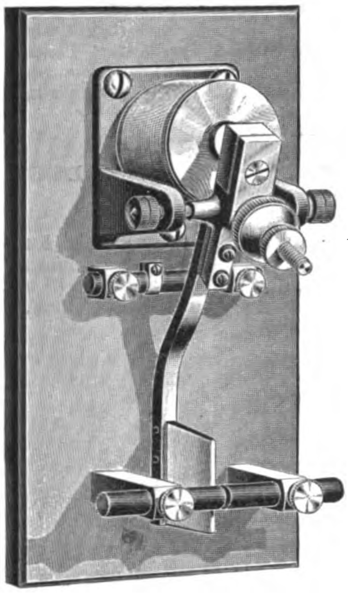
The accompanying engraving illustrates the instrument. It is of the magneto type in the strictest sense of the word, no battery whatever being used. The transmitter is attached to the face of the magneto bell used for signaling, and consists of a powerful steel magnet on the end of which is mounted a fine wire spool similar to the arrangement of an ordinary receiver. To guard against any deterioration of the magnet it is provided with a coil of wire and the current from the magneto is caused to flow through the coil, thereby strengthening the transmitter magnet every time the magneto is used. The transmitter diaphragm is made rather large and the pole of the magnet is provided with two polar extensions, so as to bring as much of the diaphragm as possible under the magnetic influence.

In a recent test of this instrument between Chicago and New York some very satisfactory results were obtained, the articulation being apparently as good as between two instruments only a block apart. The receiver is of the usual type and with the magneto bell and transmitter constitutes a complete equipment for one end of a line. There being no battery to take care of, the cost of maintenance is reduced to a minimum and the entire arrangement of the apparatus is so simple that no expert labor is required to put the instruments in successful operation. The company claim that the instruments furnished by them are fully covered by patents and do not infringe any patents not owned or not controlled by them.



The Western Telephone Construction Co.'s Magneto Transmitter.

THE DOANE LIGHTNING ARRESTER.



The Doane Lightning Arrester.

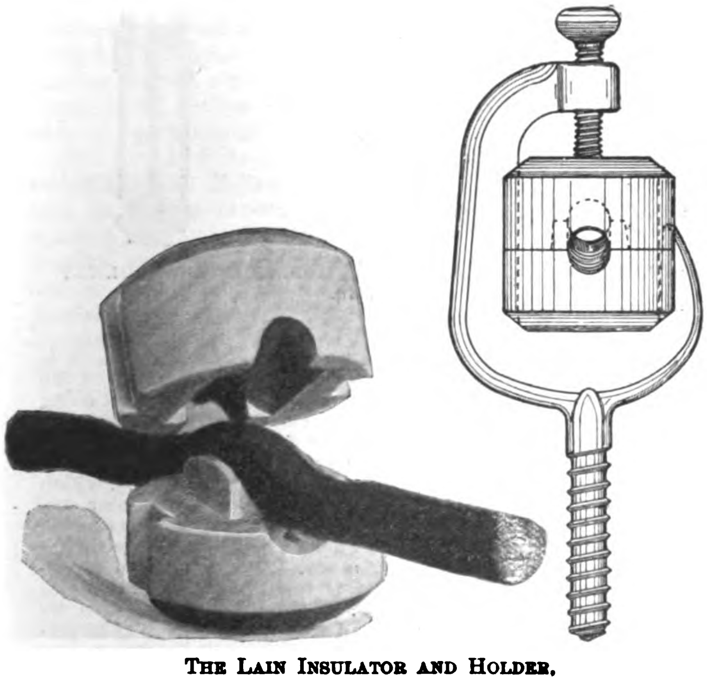
In the ordinary forms of lightning arresters the effect of a lightning discharge is to cause a short circuit of the line through the ground, by means of the arc that is formed across the carbon points of the arrester. This short circuit, although it exists only an instant, is oftentimes sufficient to cause damage to some portion of the electrical circuit, especially if the coils of an armature are embraced in it.

In the Doane arrester, shown in the accompanying illustration, and recently introduced by The W. S. Hill Electric Co., of 133 Oliver Street, Boston, the short circuit is made through a non-inductive resistance, sufficient to limit the current that will follow the lightning discharge, to an amount that cannot do any injury. In a 500 volt circuit, with a non-inductive resistance of 100 olms in series with the arc, only five amperes can follow the discharge. This can do no possible harm, and the arc formed by the passage between the carbons is easily extinguished and without injury to any portion of the circuit.

No current passes through any movable parts of this arrester, and with only a limited current through the carbons, they are practically indestructible.

THE LAIN INSULATOR.

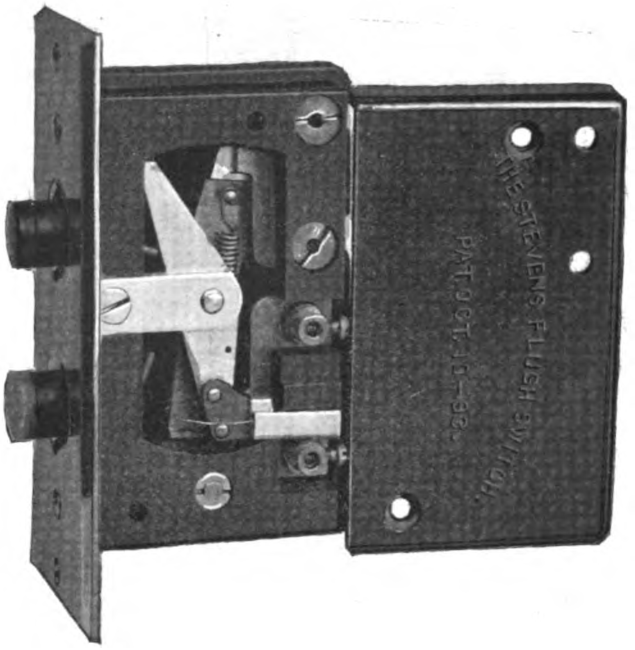
The Lain insulator, for which a patent has been granted to Mr. A. R. Lain, and which is being introduced by Mr. Robert E. Lain, of 115 Broadway, possesses several distinct features of novelty. The accompanying illustrations clearly show the simplicity of the device. It is made in two parts with a groove to hold the wire and the parts are fastened together by the socket that holds the insulator in place, so that no tie wires are required, and no chafing can take place. They are designed for electric light, telephone, fire alarm, and all other wires, from the largest to the smallest, and the socket, or holder is provided with either a spike or a screw as desired and can take any position on a pole. The absence of a tie wire is said to insure less leakage than ordinarily takes place, and the insulator is cheap, quickly put up, durable and convenient for transportation.



The Lain Insulator and Holder.

THE STEVENS FLUSH SWITCH.

The accompanying illustration shows a flush switch recently introduced by Mr. F. Stevens, 983 Chestnut street, Philadelphia, and containing a number of novel and interesting features. The switch occupies a mortise half an inch wide and three and a quarter inches long. The base is of vulcabeston and does not require to be opened for wiring, as the wires are not twisted about the screws but are simply pushed through holes in the case and fixed in position by screws whose heads appear upon the outside. The break is double pole and half an inch long and the switch is very easily operated by a slight pressure upon one of two buttons; a pearl one for switching the light on and a black one for breaking the circuit. These buttons, contrary to the usual practice, are both out at all times, though only one at a time is operative, and the mechanism is so arranged that but one spring is required for both levers. The switch is made in single, double and three-way patterns.



The Stevens Flush Switch.

PHILADELPHIA NOTES.

An electric light plant will soon be installed in the Star Theatre on 8th street.

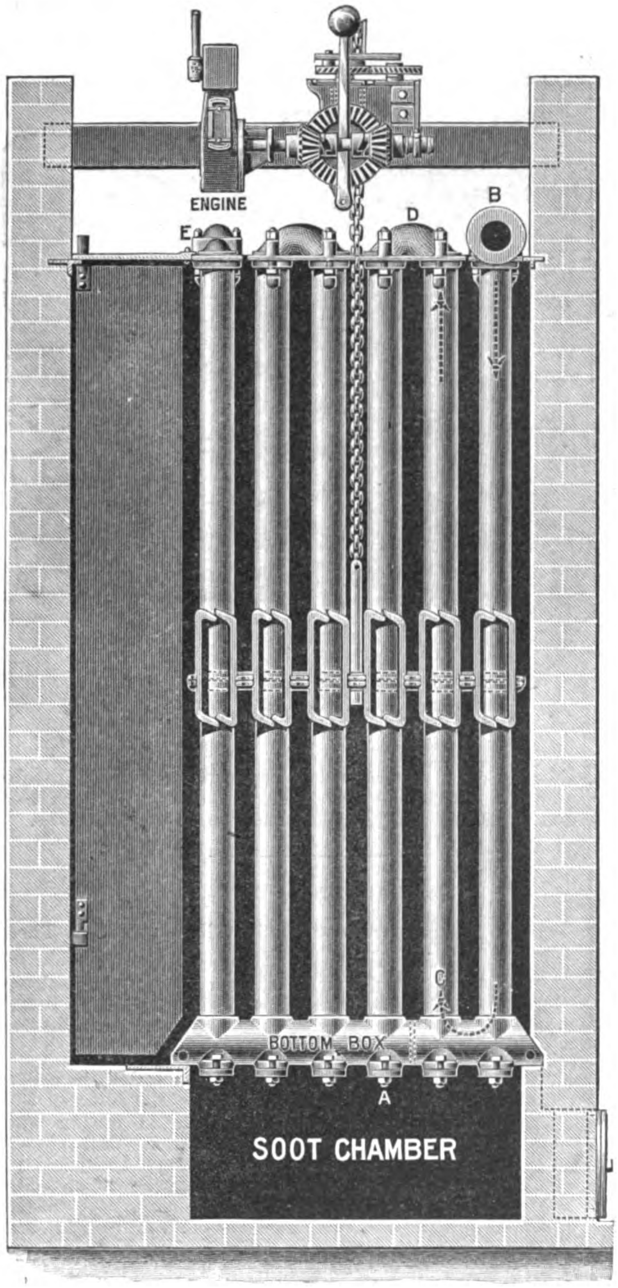
Mr. C. B. Crosby who for the past year has acted as salesman for the Harry S. Smith Co. has resigned his position to accept a similar one with W. C. McIntire & Co., who represent the Eddy Motor Co.

Harry S. Smith and Co., Ltd., have been awarded the contract for the electric light and signal systems from the Bank of North America, 309 Chestnut street, Philadelphia. All wiring will be run in brass covered Interior Conduit; insulation on all wires will be rubber covered, manufactured by the Safety Insulated Wire and Cable Co., of New York, for whom Harry S. Smith and Co. are the Philadelphia agents. The electrical work will be complete in every respect and the contract includes bell and burglar alarm work, watchman's clock, etc.

The Phila. Engineering Works, Ltd., have received an order for one of their Corliss winding engines, from the Chamberlain Coal Co., of Pottsville, Pa., Francis A. Pocock, engineer. This winding engine has 34-inch steam cylinders, 60 inch stroke to be operated by steam at 125 pounds pressure to the square inch generated by a battery of Stirling boilers. The engine is to be of the standard Philadelphia Corliss liberating valve gear controlled by a sensitive governor of the "Porter" type, and is provided with the Stevenson link, reversed by steam gear with an oil cataract. The hoisting drums are 10 feet in diameter, 10 feet long with powerful hand and steam brakes. The adjustment of the lift is effected by a toothed gear clutch, thrown in and out with worm gearing. The main shaft bearings are 17 inches in diameter by 30 inches long and the body of the shaft between the bearings is 19 inches in diameter, the central bearing being 19 x 30 inches. The engine is to lift an unbalanced load of 50,000 pounds at the rate of 1,000 feet per minute, and, with the drums will weigh about 325,000 pounds.

THE HIRT ECONOMIZER.

The Hon. Edward Atkinson, in the course of an address delivered before the New England Cotton Manufacturers' Association a little more than a year ago, predicted that the time would come when tall chimneys would stand as monuments to ignorance and wasted material. In view of the intense interest now being taken in scientific devices for economizing fuel and the general adoption of forced draft in the more carefully designed modern boiler plants, Mr. Atkinson's prophecy seems to stand a fair chance of fulfillment.



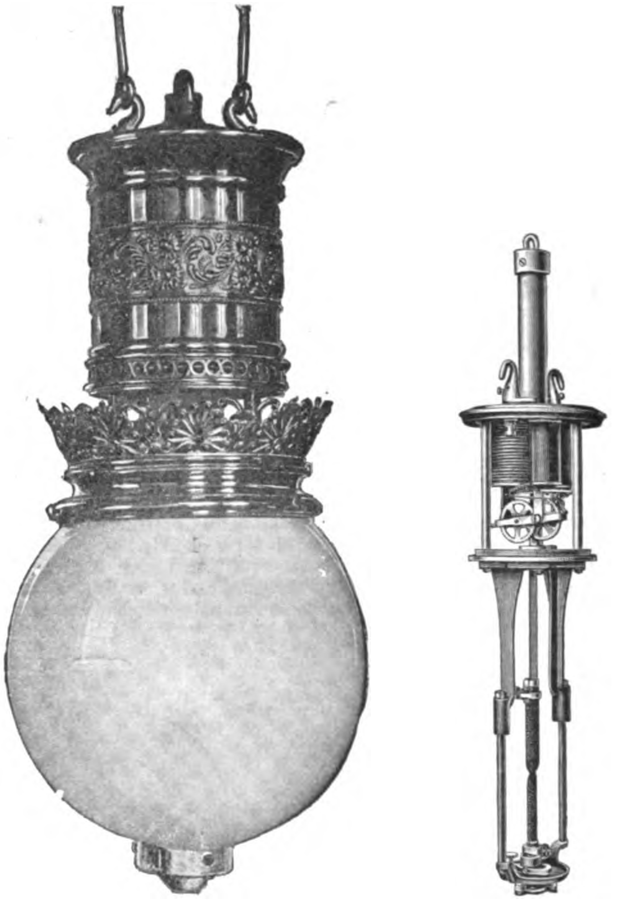
THE HIRT ECONOMIZER.

The accompanying illustration shows Hirt's patent fuel economizer, designed by Mr. L. J. Hirt, master mechanic of the West End Railway Company, in Boston. It is manufactured by the Consolidated Economizer Co., of No. 8 Oliver street, Boston, and intended for use in connection with their "Hawkins" mechanical draft apparatus, shown in their advertisement on another page. It frequently occurs in devices of this nature that, although the feed water is supposed to pass on its way to boilers, through a great number of tubes exposed to the heat of the waste gases, the construction is such that the circulation is, in reality, confined to but a few of the whole number, and the water reaches the boiler comparatively cold. With the Hirt economizer, however, this cannot occur. The water, as will be seen, enters at B and passes through the whole series of pipes, one after the other. The bend E leads to the next section, and so on throughout the whole nest. The bottom box is divided into sections as shown at C, and, to allow for expansion, no top box is employed.

The pipes may be easily and quickly cleaned, both inside and out, and the entire mechanical construction is excellent. There is a total length of 2,016 feet of pipe through which the water must pass and the efficiency of the device is, therefore very high.

THE NEW THOMSON ARC LAMP FOR INCANDESCENT AND RAILWAY CIRCUITS.

The General Electric Company announce a new arc lamp for incandescent and railway constant potential circuits. This lamp is known as the Thomson '93 arc lamp, and is the adaptation of a principle and construction patented some years ago by Prof. Elihu Thomson.



NEW THOMSON ARC LAMP FOR INCANDESCENT AND RAILWAY CIRCUITS.

The Thomson '93 arc lamp is a geared lamp but has, it is claimed, all the advantages of a clutch lamp. The feeding of the lamp is entirely independent of the weight of the carbon; it being equally regular whether with a whole carbon or one partly consumed. The lamp burns a very steady arc, noticeably free from noise, and instantly adjusts itself to any variation of potential. The principle of the feed mechanism is that of the rack rod, which carries the upper carbon-holder. This rod is of rectangular section; the rack meshes into the teeth of a pinion on an arbor in the case. This arbor also carries a gear which engages with the second pinion on the controlling arbor. Any downward movement of the rack-rod and carbon is regulated by a pawl and ratchet wheel on the second arbor. The pawl is controlled by the shunt magnet of the lamp, and the design is such as to permit a single tooth only to pass at one movement. The movements can, however, follow each other so rapidly as to allow a practically continuous feed, until the proper length of arc is obtained. The series magnet in the lamp acts to draw and maintain the arc. The lamps are adjusted for nine amperes of current with a 45 volt arc, but can be furnished for any current from 4 amperes upwards on special order.

At present four varieties of this lamp have been designed by the General Electric Company and are now ready for delivery; that for the alternating circuit is nearly completed.

THE
Electrical Engineer.

Vol. XVII. MARCH 14, 1894. No. 306.

THE ELECTRIC RAILWAY AND ILLUMINATING PLANT OF THE MILWAUKEE STREET RAILWAY COMPANY.—I.

BY

Otto Frick

By far the most prominent electrical feature of Milwaukee is the strong consolidation of the illuminating and street railway enterprises promoted by the Villard syndicate. Having acquired the old Milwaukee City and Cream City lines in August, 1890, this syndicate formed the Milwaukee Street Railway Company for the purpose of intrducing an electric railway service throughout the city, and the Edison Electric Illuminating Company, already established, was also absorbed. Later on the Badger Illuminating Company, interested in arc lighting solely, became incorporated with the others, though retaining its former name and its own management; recently the "Hinsey" line has also been acquired, and in the near future the West Side Road, or Becker Line, will cease to exist as a separate concern.

The Badger company is technically independent of the other services, and its very extensive arc light system may be the subject of a separate study, while the following description is confined to the street railway and Edison illuminating plants, for which a common power-house has been constructed with a common management and service, capable of operating all of the above installations.

The Power House; Site and Building.—Between River street and the Milwaukee River in the centre of the business quarter a favorable site, 105 feet by 115 feet, was secured for the power station at the electrical centre of the original survey, both as regards lighting and railway operations. The building, which covers nearly the whole site, presents a very plain businesslike exterior, as shown in the engraving, Fig. 1, and is of very substantial construction, utilizing the available space to the utmost.

The foundations are of concrete, carried on heavy piling and the walls are of brick with granite trimmings, and extra heavy. The north and south walls, which have to carry a great part of the weight of the engine plant on the third floor, measure, up to this floor, 40 inches in thickness, and 20 inches from this floor upward. The two front walls, east and west, have a thickness of 24 inches throughout. A heavy 48 inch brick wall erected through the centre of building is the main support of the third floor, which is formed by extra heavy 4 foot plate beams, placed 8 feet apart, the intervals being filled with cement on arches of brick and corrugated sheet iron. It looks like extravagance to locate heavy machinery 35 feet above the ground, but the problem is solved in a very satisfactory and successful way, without the necessity of procuring neighboring sites at exorbitant prices.

The dimensions of the building are 100 by 115 by 60 feet. The materials used throughout are stone and iron, thus making the whole building absolutely fire-proof. At each of the east and west walls a brick stack has been erected 125 feet high. The interior of the engine room walls is faced with white enameled brick which adds to the neat appearance as well as cleanliness of these rooms.

Lighting and Ventilation.—The building is, of course, lighted exclusively by incandescent lamps, the conductors being placed in the Interior Conduit and Insulation Company's metal covered conduits, carried on the inner surface of the walls. Ventilators run from the different floors to the roof of the building, and in addition large exhaust fans are placed to be used in extreme cases.

Space.—The problem of utilizing the available space has been solved in a most successful way which necessarily compelled a strictly systematic disposition of the different appliances. For instance, the free space in the basement, not required by foundations, is occupied by the condensing, circulating, heating and feed apparatus; north of the centre wall the railway engine room is two stories in height, while on the south side the boilers are arranged on two decks, or floors, leaving 4 feet from the south wall for coal bins, fed from the upper main coal storage bunker. The entire third floor has been reserved for the direct electric lighting and motor plant, with the exception of a 12-foot space at the south wall for this bunker.

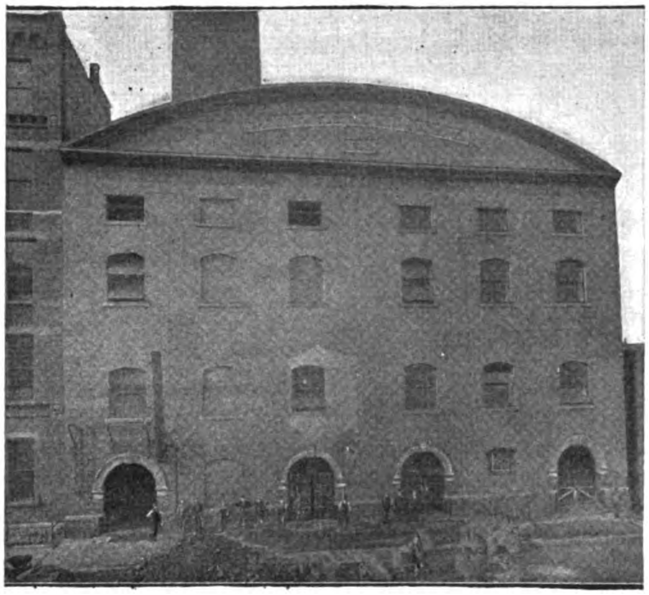
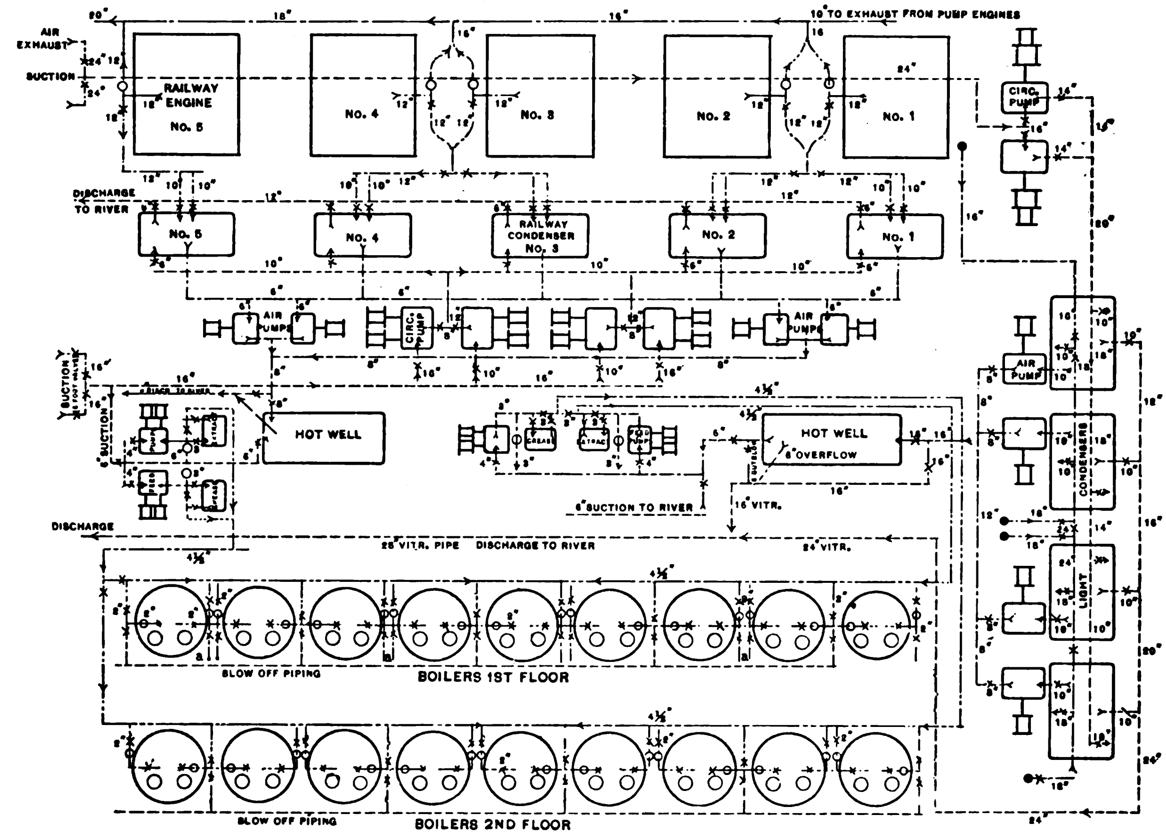


Fig 1.—Power House from River Street.

Condensing Plant—The arrangement and connections of the condensing and feed water piping will be readily understood from the diagram, Fig. 2. The condensing plants of the railway and electric light engines are totally independent of each other, the latter working on two main condensers, one a duplicate of the other, and each one individually capable of operating the whole present plant while space for two additional condensers, has been provided. Each of the railway engines has its own separate condenser, capable, however, of being thrown independently into connection with every other engine. These are all of the Wheeler surface condenser type, and are now, after two years' operation giving perfect satisfaction. The circulating water is taken from two wells on the dock front, communicating with the river through 16 inch pipes, by four Blake duplex circulating pumps, of 60,000 gallons capacity per hour each. Branches controlled by gates distribute the water to the different condensers, and all discharge back again into the river, the water being only raised 8 feet during the operation. The temperature is controlled to suit the conditions and the pumps are in duplicate. The exhaust steam from the engines passes through a grease separator of the centrifugal design that accumulates the grease and dirt and discharges it into an independent tank, thus preventing the fouling of the condenser and feed water.

Open Air Exhaust, Air Pumps and Hot Well.—An automatic relief valve is connected to the copper exhaust pipe before it enters the condensers, so placed that the exhaust can be delivered into a common exhaust pipe opening into a vertical exhaust 70 feet in height and 30 inches in diameter, located out of doors at the rear of the building, and fitted up with drains leading to the hot-well. The condensed products are taken through a 6-inch wrought iron pipe, connecting all the condensers in the railway plant and interchangeable in case of accident to any condenser, to four Blake air pumps, of a capacity of about 20,000 gallons per hour, discharging into a hot-well through a main 8-inch wrought iron pipe. The hot-well for the railway plant is circular, 16 feet in length and 4½ feet in diameter, constructed of steel plates and has a capacity of 1,600 gallons. In case of damage to the hot-well, however, the condensed water may be discharged directly into the river through an 8-inch pipe, also connected as an overflow from the top of the hot-well. All drains from engines, jackets, headers, etc., are led to the hot-well, as is also a direct steam discharge so that the temperature of the feed water can be kept at any point required and all possible heat of the feed water saved.



——— Water-pipes to and from river. – – – – Steam and water from eng. through condensers, air pumps, hot-well to feed-pumps. ·——— Feed water from pumps to boilers. O Relief and check valves. × Gate valves. ● Exhaust-pipes from third floor lighting engines. Arrows indicate the direction of flow.

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FIG. 2.—DIAGRAM OF CONDENSING AND FEED PLANT.

Lighting Condensing Plant.—The condensers for the electric lighting plant, as before stated, are in duplicate, built beneath the sidewalk in front of the building. They consist of two large Wheeler condensers, supplied by two Blake tandem compound circulating pumps, each having a capacity of about 200,000 gallons per hour, and two Blake 50,000 gallon air pumps. The circulating water is taken in the same way as for the railway engines, through 24-inch pipes, and discharged back into the river through Vitrite pipes 30 inches in diameter.

Lighting Plant.—The lighting plant is on the upper floor and the engines and dynamos are of the same style as those of the railway plant, arranged with oil separators and exhaust piping as shown in Fig. 3. Automatic relief valves, similar to those used on railway engines, connect with the main open-air exhaust. The condensers for the lighting engines discharge into a separate hot-well 22 feet in length, with a capacity of 2,200 gallons, fitted up in a similar manner to the hot-well of the railway plant. The average vacuum maintained at the engines is from 23 to 25 inches.

Feeding Plant.—To secure water for the feed pumps four different combinations have been provided: 1. Hot water is taken from the hot-well; 2. City water can be used to fill the hot-well; 3. Through a by-pass on the condensers river water can be transferred from the water to the steam chamber; 4. The feed pumps can take water directly from the river. For each hot-well two duplex feed pumps of 7,000 to 8,000 gallons capacity are connected each with a Wass grease, air and mud extractor. The water is taken from the hot-wells by 6-inch pipes and led to the pumps by 4-inch pipes; before reaching the extractors a safety escape is offered to the feed-water, allowing it to flow back in the suction pipe through 3-inch relief valves, thus allowing the feed pumps to be run at a steady rate of speed, no matter how the actual feeding at the boiler fronts is being operated. As shown in the diagram, two 4½-inch pipes start from the two extractors, belonging to the second hot-well, the one passing along the first floor boilers, the other along the second floor boilers. These meet and connect with the pipe from the two other pumps at the west end of the first floor boiler room. The boilers are connected by 2-inch pipes and valves to these headers and to the blow-off pipes, as indicated in Fig. 2. A secondary line has been provided for the first floor boilers of two 2½-inch pipes, running along the back of the boilers, and communicating with the railway feed pumps and pipe ends A at the front of the boilers, to guard against accident to the main feed pipes.

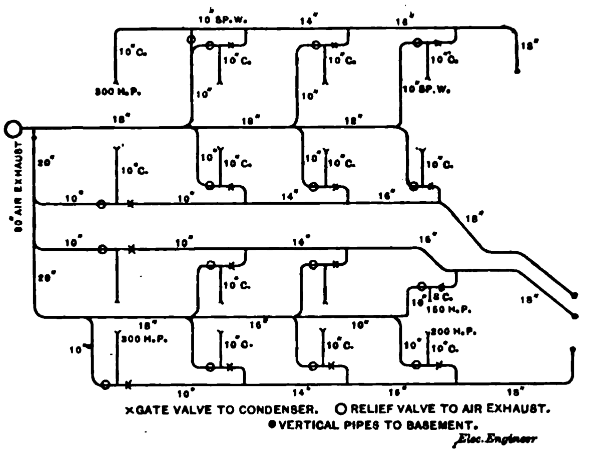


FIG. 3.—EXHAUST PIPING FOR LIGHTING ENGINES.

Boilers.—There are eighten boilers of the Galloway internal double flue type, with all the latest American improvements, manufactured with special reference to the work required, by the Edge-Moor Iron Company, of Edge Moor, Delaware, for a working pressure of 160 pounds, capable of generating 250 h. p. at 15 pounds per h. p. hour; this is the estimated quantity required for the triple compound engines of the Edison type at their maximum efficiency point. The boilers are 27 feet in length by 7 feet in diameter and have a flue space all around the shell enclosed with sheet iron, mineral wool and brick, making a very efficient battery. The flues of the boilers on each of the two floors are divided so that one half go to one stack and the other half to the other, thus allowing one quarter of the whole boiler plant to be repaired at any time when necessary without interfering with the operation of the rest. The arrangement is shown in Fig. 4. The boilers are also fitted with direct forced draft which can be used when necessary without interfering with the ordinary firing. Some of the boilers have now been in operation for over two years, and up to the present time have required absolutely no repairs; only one tube has started to leak and that was due to a blister in the material. It may also be here stated that at the time of adopting these boilers they were the only ones on the market capable of supplying steam at high working pressure.

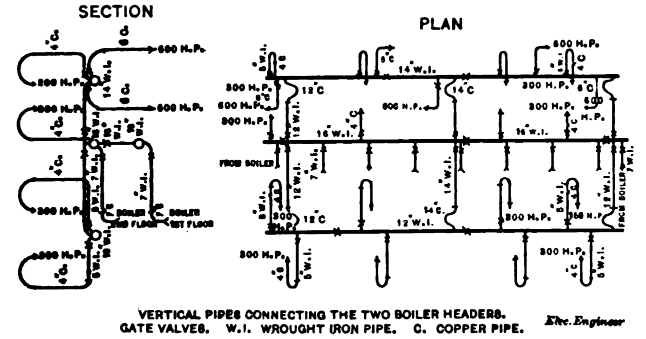


FIG. 5.—DIAGRAM OF STEAM PIPING.

Forced Draft—The stacks, being only 125 feet high on account of the unstable ground upon which they are built may, under unfavorable conditions prove insufficient to produce the necessary draft, and forced draft apparatus has accordingly been installed. This consists of four 60 inch fans driven by 5 x 4 inch double upright direct coupled steam engines, manufactured by B. F. Sturtevant, of Boston, Mass. The air is taken from the different parts of the building where heated air is likely to accumulate, thus greatly aiding the ventilation, and is forced into two large sheet iron conduits which connect under the fire-room directly with the furnace. The system is divided into two complete sections which are interchangeable.

Coal Storage and Ash Handling Apparatus.—The problem of storing and handling coal was a difficult one, owing to the contracted space available, and its solution has been remarkably happy. The coal is taken either from the street, where it is unloaded through an opening in the side-walk, into the basement, and lifted by elevators to the top floor, or, it may, by means of a second elevator on the river side, be directly hoisted from barges to the main large coal bin on the upper floor, whence it is distributed by a reversible conveyer. From this bin, or bunker, it descends by gravity through small channels to the other bins alongside the south wall in front of the two boiler batteries, as shown in Fig. 4. The storing capacity of the bins is about 600 tons. The ashes are taken away from the front of the boilers through conduits and delivered by elevators into bins at each end of the building where they descend by gravity either to wagons on the street or to barges on the river. The conveyers and elevators both for the coal storage and ash handling apparatus are driven by electric motors. The plant was installed by the Link-Belt Machinery Company, of Chicago, Ill.

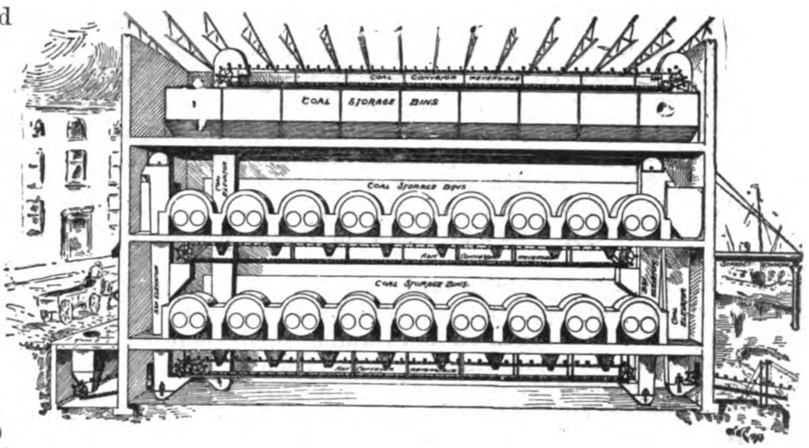


FIG. 4.—COAL STORING AND ASH HANDLING APPARATUS.

Steam Piping.—A diagram of the steam piping is shown in Fig. 5. The boilers are connected by 7 inch wrought iron pipes with large copper bends to two 16-inch headers, running along the south wall of the engine room and connected by three vertical pipes. From the upper header the steam is led to two sub-headers, 12 and 16 inches in diameter, respectively, from which it branches to the engines. Copper has been very extensively used to secure sufficient elasticity, and by well placed valves it is possible to shut off any part of the piping independently. Before entering the engines the steam passes through a centrifugal trap to be relieved from all entrained and condensed water. All flanges were specially designed for the high pressure used and are faced, turned and connected by fitted bolts. All joints are of brass wire gauze and litharge cement, and are in first class condition, and all piping and connections are covered with magnesia non-conducting blocks.

THE COPPER-ZINC ACCUMULATOR.—V.

(*Concluded.*)

D Paul Schoop

A NEW PROCESS OF MAKING COPPER ANODES WITH POROUS SURFACES.

As has already been set forth, the active material for the copper electrode, is applied *mechanically* to a copper support; while Desmazures uses spongy copper, which he applies by means of great pressure to a net-work of copper wire, Phillips and Entz make use of finely ground oxide of copper, which is pressed as a paste into the meshes of a copper cable. So far, both proceedings are very similar to the well-known process of "pasting" lead plates, covered by Faure's and Brush's patents. It might also be possible to render a copper electrode porous by an electrolytic process, similar to Planté's invention, for instance, but perhaps the best and most practical way is the following:

At ordinary temperatures, copper does not readily combine with oxygen, except in a very finely divided powder and the facility for combining increases at higher temperatures. Solid copper, either cast or wrought, begins to absorb oxygen at a temperature near 400 degrees C., and is covered by a black coating of oxide of copper. But this layer protects the subjacent copper from further contact with oxygen and prevents the deeper penetration of oxygen.

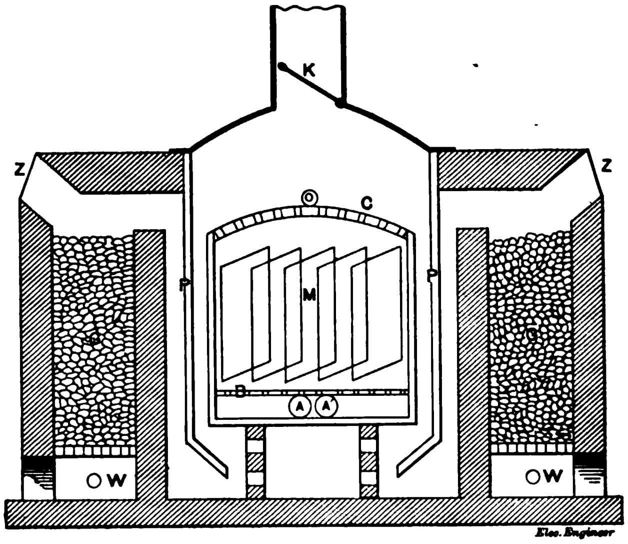
If the temperature is raised, say, to a full red heat, the black oxide of copper reacts upon the metallic support, giving part of the oxygen off and forming suboxide of copper. If now, at the same time, air or oxygen is permitted to circulate around the copper piece, the effect is that its surface can be oxidized to any desired depth; even so far that no more metallic copper is left, but the whole is transformed into oxide of copper.

This is not, however, what is wanted for our purpose. The surface should be oxidized to $\frac{1}{8}$ or $\frac{1}{16}$ of an inch and have a metallic support left of sufficient conducting power. To perform the desired result is a matter of maintaining the proper degree of heat; since the right temperature is very near the point where the oxide of copper fuses, some care has to be taken to prevent too high a temperature. One great drawback will be found, and that is, that while the article is cooling down, the oxide of copper blisters and cracks off; the contraction of the oxide of copper is different from that of the metallic copper and therefore the brittle oxide detaches itself from the metallic core. It is still possible, however, to attain a practical result. Before that point is reached at which the oxide cracks off the surface, it can be reduced to copper by contact with, for instance, carbonic oxide. The porous copper thus formed, adheres firmly to the solid core, and repeating the process once or twice, the porosity of the superficial layer can be brought to any desired degree. Of course, the second time, the temperature for effecting the combination with oxygen is much lower, only about 300 degrees C., and there is no more cracking off of oxide, or the temperature may be chosen so low as only to allow the formation of suboxide of copper; in this latter case the copper electrode is quite ready for use in the accumulator.

This process for making porous copper electrodes may be advantageously carried out with the aid of the apparatus described below, and which is shown in the diagram. In the centre of the cylindrical furnace is placed a muffle M of refractory material, such as magnesia or china clay. This muffle has a false, perforated bottom B and a perforated cover C. Below the false bottom there are two inlets A and A′; A is for the supply of air, A′ for the supply of carbonic oxide or generator gas.

P is a partition wall of insulating material, like asbestos or any other refractory substance. The generator G, which surrounds the muffle and partition wall is filled with coke by the supply-holes Z. A chimney K surmounts the generator. The copper is first put in the muffle and raised to the necessary red heat, while air is introduced through the inlet A. When the copper is sufficiently and uniformly oxidized, the air is stopped and the generator cooled down by blowing steam through the pipes W. At the proper time, the inlet A′ is opened and carbonic oxide or the water gas produced in the generator, is let into the muffle, where it reduces the copper oxide to porous copper. This operation is then repeated, but at much lower temperatures, in order to obtain the desired porosity of the layer.

After a little practice, it is possible to treat a large amount of copper each day in this way. The time of the whole treatment is about three hours. There is, perhaps, no cheaper and more rapid way for rendering copper porous, but there are still other interesting points connected with this method.



SCHOOP'S FURNACE FOR OXIDIZING COPPER.

1. The layer of porous copper adheres so firmly to the core of the electrode, that no mechanically applied layer could be compared with it. The copper may be bent many times and in all directions without detaching the layer.

2. The form of the copper electrode may be of any description, without interfering with the application of the porous layer. It need not be a wire netting or loosely made cable or a grid or any special form adapted to retain the active material firmly. For several reasons, a plain copper sheet is the most desirable form.

3. An electrode, made according to this process, does not infringe any patents, covering the mechanical application of active material to a support (paste, paint or cement).

4. The heating process must be cheaper than any electrolytic process, because no chemicals are used and the air and generator-gas are the cheapest agents possible.

5. The labor and hand work is almost entirely eliminated.

After the copper electrode has been treated, it must be covered or surrounded by a partition or membrane; since it is very doubtful whether organic substances like cotton (cellulose) or parchment paper (hydro-cellulose) are likely to stand the action of the strong caustic electrolyte without injury to the cell. The copper electrode is put preferably in a porous pot made of magnesia. The magnesia is entirely stable and may be made of any desired porosity. It may also be impregnated with substances that attract those traces of soluble copper compounds, occasionally formed, and thus impart to the copper accumulator that amount of reliability necessary for its practical success. Dolomite may also be used as material for the porous cup instead of magnesia.

UNDERWRITERS INSULATION REQUIREMENTS AND THEIR INFLUENCE ON THE QUALITY OF WIRES.

BY

H. C. Cushing Jr.

Every piece of insulated wire that is to be used for lighting or power purposes in the city of Boston has to be subjected to a very careful insulation test before it can be used in any building within the city limits. This test is made by the Boston Fire Underwriters Union, and a similar test has to be made for the New England Insurance Exchange before they will pass upon its use in any building in New England, outside of Boston. Although neither board can enforce the removal of a single piece of disapproved wire or wiring they can so add to the insurance rate on the building in which the wiring is done that the owner soon comes to the conclusion that there is really danger of fire and out comes the bad work which is replaced by good wire and good workmanship.

Electric lighting, as we all know, is the safest mode of illumination when properly installed; yet there is nothing so likely to set fire to a building as electricity when carelessly handled. With the knowledge of this fact the insurance companies, all over the country, have adopted rules which have been very carefully compiled by men of long and varied experience in electrical construction work and as every piece of wiring, either for lighting or power, is now thoroughly inspected before the current is turned on in the building, and due to the fact that we are getting better wire and fixtures every year, it is safe to say that there is no possible chance of a fire from electricity if the wireman and inspector does his duty according to the present rules and requirements.

Although we have had numerous makes of insulated wire for a number of years it is only within the last two years that we have had uniformly excellent wire insulation. Not that we have not always had the insulating material but the method of manufacture has been crude. Rule 12, of the Rules and Requirements of the Boston Fire Underwriters Union, state that :

> "Insulation that will be approved for interior conductors must be solid, at least $\frac{3}{64}$ of an inch in thickness and covered with a substantial braid. It must not readily carry fire, must show an insulation resistance of one megohm per mile after two weeks submersion in water at 70 degs. Fahrenheit, and three days submersion in lime water, with a current of 550 volts and after three minutes' electrification."

Every test on samples of insulated wire, furnished by over fifty manufacturers, has been kept on file by the Boston Fire Underwriters Union since March, 1888, and each year since then has shown a vast improvement over the previous year as to quality of wire, insulation, finish and power to withstand abrasion.

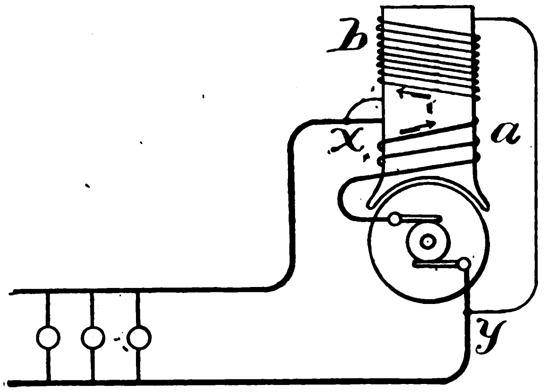
The samples of wire submitted in the year 1888 showed a very uncertain quality, the insulation showing a resistance of from 1800 megohms to 3.3 megohms per mile upon being submerged in water and many of the samples showed no resistance whatever after having been in water five or six days with only 140 volts used in making the measurements. This clearly showed the presence of pin holes, flaws and a non-homogeneous coating of the insulating material, a state of affairs that recent tests show to be rapidly disappearing with the modern improvements in manufacture to meet various requirements.

This inferior or uncertain quality of insulation continued to pour in until December, 1892, but from that date up to the present time a wonderful improvement has been noted and the tests on all samples, submitted by over fifteen different manufacturers, show that in no case has the insulation resistance dropped lower than 220 megohms, after having been submerged in water for fourteen days and then in lime paste for three days, and each reading being made with a potential of 550 volts; while several samples showed a resistance of over 4,400 megohms after the same severe test.

We thus see that the manufacturer has more than met the insurance requirements and it is certainly very gratifying to both parties to note the steady improvement in the manufacture of insulated wire upon which depends the safety of our buildings and the lives of our linemen, as the insulation requirements hold good for outside as well as interior conductors.

THE LEWIS SELF REGULATING CONSTANT POTENTIAL VARIABLE SPEED DYNAMO.

In recent issues we gave a description of the electric car lighting system of the Lewis Electric Co., and of their windmill plant designed as a source of electrical energy; both being operated in connection with storage batteries. In the one case we have a dynamo driven from the car axle and in the other by the windmill through gearing. The character of both these driving agents is identical in the variable nature of the speed to which the dynamo must necessarily be subjected and our readers will recall the fact that in those descriptions we stated that the inventor, Lieut. I. N. Lewis, U. S. A., had designed a very simple method for obtaining a constant potential at the battery terminals, without introducing any auxiliary regulating apparatus, which has heretofore so greatly retarded progress in this direction. We are now able to describe the method alluded to, which consists simply in a special method of winding the field magnets of the dynamo.



Lewis Constant Potential Variable Speed Dynamo.

In the ordinary method of compounding dynamos for constant potential where the driving speed is constant, the current in the series coil acts cumulatively with the shunt to maintain the strength of the field magnetism. To accomplish the maintenance of constant potential with *varying* speed, however, Lieut. Lewis simply reverses this order of things and connects the series coil differentially or reversely, so that its acts to demagnetize and weaken the field as the speed increases. The method will be readily understood by inspection of the accompanying diagram which shows the long shunt method of connection, the same principle of course holding true with the short shunt. The shunt coil is here shown at *b* and the regulating differential series coil at *a*.

The results obtained in practice with this method of winding are quite remarkable. In some recent tests with speeds varying between 600 and 800 revolutions and with current varying from 1 to 35 amperes, the potential did not vary more than 1 volt from the normal 35 volts for which the machine was designed. With such a machine available the problem of electric car lighting and windmill storage is in a fair way to find a speedy solution.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE CHLORIDE ACCUMULATOR ON PARIS STREET RAILWAYS.

Some attempts at electric traction by accumulators have been made in these latter years in France as well as in other European countries but nearly everywhere this method of traction has been abandoned, principally on account of the failure of the system of accumulators employed. The Street Railway Company of Paris and the Department of the Seine once abandoned the system after a few months' use on its St. Denis lines. Now, however, it is no longer a question of mere experiment, but one of genuine industrial development. The installation of the St. Denis station has been made in view of the development of two lines, each about six miles in length. They both extend from the rond-point de Picardie at St. Denis, the one to the Madeleine, the other to the Opera. The first trials took place in February, 1892. Electric traction has been employed regularly on the portions of the two lines situated outside of the city walls since June 1st. Horse cars were entirely done away with on the Madeleine line October 1, and will shortly be abandoned on the Opera line. A third line, about three miles long, running from the mayoralty house of St. Ouen to Neuilly, will soon be operated by electric cars.

The plan laid out for the constructors of the motors and accumulators was to substitute for the horse cars on the two lines above designated, self-propelling cars, with seats on the roof, having a carrying capacity of fifty passengers and two company employees. The lowest speed imposed, with full car, was seven and a half miles per hour, with the possibility of attaining a speed of ten miles an hour outside of Paris, and a minimum rate of three and three-quarter miles on the heaviest grades, which are about four per cent. Moreover, the company reserved the right of attaching another car to the electric cars. The daily mileage of each car was to be at least sixty-five miles, and the weight of the accumulators, including all accessories, was not to exceed 6,000 pounds. All these conditions have been fulfilled to the letter.

The body of the car rests on rollers upon two trucks, each having one axle, and being held in place by a king bolt. These two trucks are bound together by a system of joints and springs, which allows the axles to converge on curves and restores them to parallelism on a straight track.

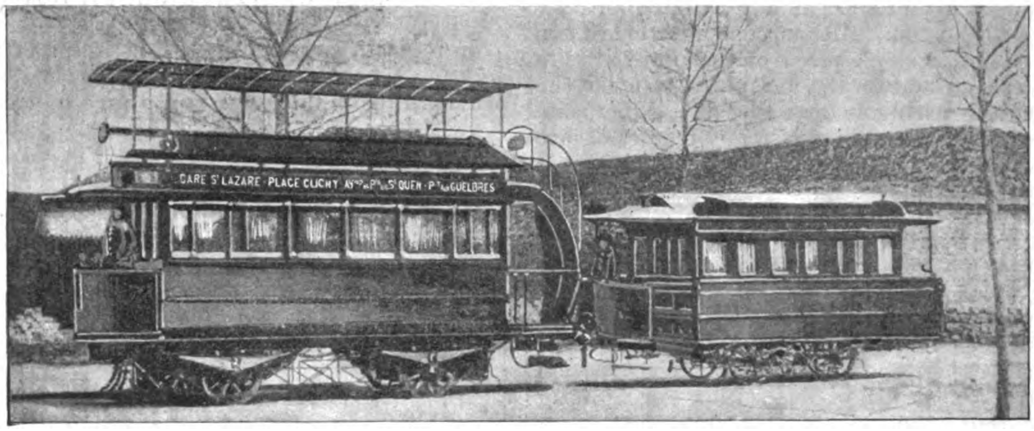
A motor is attached to each axle by double-reduction gear wheels, the ratio between motor and axle being twelve to one. The gears are in an iron casing, the first pair completely immersed in oil. The motors are bi-polar, of the Manchester type, with Gramme armature, series wound. The brushes are four carbon blocks. Each motor will develop, with a speed of 1,850 revolutions per minute, a power of 10,000 watts, with a difference of potential of 200 volts. Under these conditions the efficiency between motor and axle is seventy-three per cent. The trucks and motors were supplied by the firm of Averly, of Lyon, and M. Lemoine's roller brake is used.

The accumulators are of the chloride type, manufactured by the Société pour le Travail Electrique des Métaux, to the operation of which its distinguished director, M. Sarcia, has imparted a very remarkable impulse. The accumulators are placed under the seats of the car. There are one hundred and eight elements of eleven plates each contained in hard rubber boxes. The plates are seven and three-quarter inches by seven square and a quarter of an inch thick, and the weight of an element is thirty-eight and a half pounds. These one hundred and eight cells are divided into twelve groups of nine batteries each, contained in twelve wooden boxes, six on each side of the car, the batteries of each group being connected in series, and the two terminals attached to copper strips fastened to one of the partitions of the wooden box.

To the wooden props of the car are attached brass springs connected to the motor circuits, with intermediate regulating switches. The introduction of the boxes into the car causes these springs to slide on the copper strips and the circuit through the constituent parts of the battery is thus automatically established. The batteries are charged on a platform made of joists, covered with tar, supported by brick piles and supplied with glass insulators. These platforms have brass contact springs like those in the cars. The batteries when placed on the platform for charging are connected in series. The station for accumulators has space for twenty-four sets of batteries, each one connected to a distributing switchboard by a special circuit, in which is an ammeter, a polarity indicator, a double-pole circuit breaker and a make and break switch.

The transfer of the batteries between the charging tables and the cars is effected by means of small cars moving on tracks which run alongside of the platforms and the street car tracks. When a car returns to exchange its discharged battery for another, seven of these transfer cars are ranged on each side of the tracks, six carrying boxes of accumulators freshly charged and the seventh empty. The first box of batteries contained in the street car is slid on the empty transfer car by which it is carried to the place which it is to occupy on the charging platform. The first box of the new battery passes from its transfer car into the space in the street car thus left empty, and a second box of discharged battery is removed, and so on consecutively. The platform of the transfer car can be raised and lowered by a screw and fly wheel so that it can be brought to the level of the interior of the street car or of the charging platform. This is accomplished in five minutes or less.

The charging current for the accumulators is furnished by three Desroziers dynamos, constructed by the firm of Bréguet, each run by a one hundred and twenty-five horse-power Corliss horizontal condensing engine. Two of these engines run at a speed of seventy-five revolutions, and the third at one hundred and sixty revolutions. This last runs its dynamo by means of a single belt, the other two by intermediate shafting. The engines are supplied by three semi-tubular boilers. This plant was installed by M. E. Garnier.



PARIS STREET CAR OPERATED BY CHLORIDE ACCUMULATORS.

Each dynamo, at a speed of 600 revolutions, develops a current of 280 ampers, with an electromotive force of 260 volts, and the sets of accumulators are charged in parallel, with a constant electromotive force of 260 volts. The duration of the charge is six hours for a battery which has furnished all its capacity of 280 ampere hours, or fifty-two horse-power hours. The yield in energy of the batteries is as high as seventy per cent. The batteries in service, with an electromotive force of upwards of 200 volts, give a discharge, which on grades reaches seventy amperes, or nearly two amperes per pound of element. The average output on the level is about thirty-five amperes, which increases to fifty-five amperes on grades of two and a half per cent. One charge of the batteries will run the car about forty miles on grooved rails and about seventy-five miles on ordinary T rails.

In order to operate the car at the various speeds required in service the coupling of the cells of battery is changeable. In the car the batteries are divided into four parts, each of twenty-seven cells in series, which give, on closed circuit, about fifty volts. By means of a regulating switch, placed under the control of the driver, three couplings of batteries may be obtained of 50, 100, or 200 watts. The speed of the car is doubled in passing from one coupling to the other. The motors of the car are usually connected in series, but, by means of a switch, may be placed in parallel when greater speed or power is required. This second switch also reverses the direction of running of the car by reversing the current in the motor armatures, and by it also a motor may be cut out of service in case of damage by short circuiting on the series combination. A single motor is sufficient to run the car with a slightly reduced speed.

The switch for altering the coupling of the sub-batteries consists of a cylinder of non-conducting material, carrying three sets of copper strips, corresponding to the three couplings or combinations of the batteries. These strips become connected when the cylinder is revolved on its axis between the metallic brushes, communicating with the sub-batteries. In passing from one position to another the current is broken before the strips are released from between the brushes, the break being made on special strips supplied with blocks of carbon, so arranged as to be easily replaced. The barrel is revolved by means of a lever. The switch or regulator which changes the couplings of the motors is composed of three commutators, operated by separate cranks, which are so interlocked that they cannot be operated except when the current is broken by the battery switch.

The daily service on the Madeleine route (the only one at present entirely operated by electric cars), consists of one hundred and four trips, or fifty-two round trips. Seven cars are operated on this line, some making eight and others nine trips, about ninety-two and one hundred and three miles; while horse cars make not much more than sixty miles. Each car is operated with two sets of batteries, making from four to six consecutive trips, forty-six to sixty-nine miles without recharge. The running time between terminals is fifty-five minutes, including stops. The weight of a full car is about 29,000 pounds, of which 5,700 pounds are for the batteries and their accessories and 7,700 pounds for the passengers. The mean tractive force is about twenty-six and a half pounds per ton.

The average results of operation on the Madeleine line for October, November and December, 1892, per car mile are as follows: Ampere hours charged, 6.2; horse-power hours, generated, 2.2; coal consumed, 9.2 pounds; oil consumed, .015 pound. The averages for a whole year would be lower, as the average for the three months considered is relatively high in consequence of the heavy condition of the road due to mud, snow and ice. The road is built of T rails, weighing about fifty pounds to the yard, except in St. Denis and Paris, where the Broca grooved rail is used, weighing about ninety pounds to the yard. The service has been very regular and the receipts per car mile have increased to a marked degree, and the favor of the public has been instantly won by the new, comfortable cars lighted by electricity.

Encouraged by the good results obtained, the street car company has determined to introduce storage battery traction on their other lines. On the new cars, which are to be built, a system of regulation is to be employed whereby, in stopping the cars and in running down grades, the motors will become generators, and a portion of the energy previously given out by the accumulators restored. Great credit is due to the manager and directors of the street railway company through whose efforts and perseverance storage battery traction has triumphed in Paris, and will, it is thought, be speedily adopted throughout France.

BRISTOL AND TRENTON ELECTRIC RAILWAY.

The first link in the chain of electric railways which will eventually connect New York and Philadelphia is now well under way. The Philadelphia division between Bristol and Trenton, 34 miles in length has been surveyed and that section alone will include a mile of bridge work. The contracts for construction will soon be let. Mr. A. Langstaff Johnston, consulting engineer, has charge of the work, which will be pushed to early completion.

CAPACITY OF RAILWAY MOTORS.

BY

E. A. Merrill.

THE usual traction formula or table gives the draw-bar pull required to keep a given load in motion either at a very slow speed or at some specified speed and with a specified coefficient of resistance. While these tables are applicable at all speeds to locomotives and other engines where the tractive power may be kept constant and the power consumed varies directly with the speed for any given tractive power, they are not at all applicable to electric motors in which the tractive power is constantly varying independently of any method of motor control, and in which the energy utilized in propelling the load may be, and often is, very different from the total energy consumed.

To illustrate: A certain table gives .32 h. p. as the power required to propel 1 ton at a speed of 4 miles per hour, on a level, with a coefficient of resistance of 30; a 50 h. p. equipment should therefore be capable of propelling 156 tons at this speed without exceeding its rated h. p.; this might easily be true for a steam locomotive but is assuredly not for an electric motor which, if geared for a normal speed of 12 miles per hour, will reach its normal *ampere capacity* at 52 tons. The table is therefore unreliable and almost useless at all speeds and loads except those at which the motors will give their rated output.

The reason for this discrepancy is found in the fact that the tractive power of the locomotive can be varied widely and for indefinitely long periods without undue strains on the working parts, while electrical and mechanical limitations practically compel a maximum tractive power in the motor not far above its normal capacity except for very short periods; this tractive power, aside from magnetic variations in the iron, is dependent upon the ampere capacity of the motor windings and is practically the same for all speeds; therefore, as the coefficient of resistance in street railway work will not vary by any determinable amount for speeds up to 12 or 15 miles per hour, the maximum load that can be propelled at any speed will not exceed the maximum load that can be propelled at its rated speed so long as the normal tractive power is not exceeded; the speed will vary directly with the E. M. F. at the motor terminals.

This indicates a simple method of ascertaining what is more important than the total horse power consumed in moving the load, viz., the proportion of the normal tractive power which must be excited to move any given load, the rated horse power and normal speed of the motor at the E. M. F. of the line being known. For, from the horse power and speed at which that horse power will be developed the pull at the periphery can be determined and this pull is independent of all variations in wheels, gears, speed reductions or armature diameters, and also holds true per horse power for any size of motor.

If we know the ratio of tractive power exerted to normal tractive power we know pretty accurately how far the proper carrying capacity of the armature and field windings is being utilized or overloaded; the total horse-power consumed does not give the remotest indication of this important point. To determine this ratio the writer has used the following table which is presented with the hope that others may find it equally useful; it is based on the assumption that the rated horse-power of the motors can be applied at the periphery of the driving wheels at the rated speed without overheating fields or armatures.

LBS. PULL AT PERIPHERY OF WHEEL AT RATED H. P. AND SPEED.

Rated speed. Miles per hour.	8	10	12	15	18	20	25	30
15 h. p. Equip.	703.1	562.5	468.8	375.	312.5	281.3	225.	187 5
20 " "	937.5	750.	625.	500.	416.6	375.	300.	250.
25 " "	1171.9	937.5	781.3	625.	521.	468.8	375.	312.5
30 " "	1406.2	1125.	937.5	750.	625.	562.5	450.	375.
40 " "	1875.	1500.	1250.	1000.	833.2	750.	600.	500.
50 " "	2343.8	1875.	1562.	1250.	1043.	937.5	750.	625.
60 " "	2812.4	2250.	1875.	1500.	1250.	1125.	900.	750.

To determine the maximum normal load in tons, divide the pounds pull by the resistance per ton; thus on a 10 per cent. grade the maximum normal load would be for a 50 H. P. equipment whose normal speed was 12 miles per hour: $\frac{1562}{30 + (10 \times 20)} =$ 6.8 tons.

The formula is: $\frac{\text{Lbs. pull}}{\text{Resistance}} =$ Load in Tons.

To get the ratio of tractive powers, divide the actual load by the normal load; thus, if the actual load is 10¼ tons the ratio is

$$\frac{10.25}{6.8} = 1.5,$$ or the motors are propelling a load which demands an increase in current above the normal sufficient to increase the normal tractive power by one-half.

On the above basis the following table has been figured, giving the tons that can be propelled per rated horse power without exceeding the normal tractive power. It will be noted that the speeds given are the normal speeds for which the motors are designed; the actual speed will take care of itself, varying with the actual load and the voltage at the motor terminals; the coefficient of resistance is assumed to be 30.

TONS PER RATED HORSE POWER AT PERIPHERY OF WHEELS WITH NORMAL TRACTIVE POWER.

Normal Speed. Miles per Hour.	8	10	12	15	18	20	25	30
Level..................	1.56	1.25	1.042	.83	.694	.625	.50	.416
1 % grade............	.937	.75	.625	.50	.416	.375	.30	.25
2 " "	.67	.536	.446	.356	.298	.268	.214	.18
3 " "	.52	.416	.347	.277	.231	.208	.166	.139
4 " "	.426	.341	.284	.227	.189	.170	.136	.113
5 " "	.36	.289	.24	.192	.16	.144	.115	.096
6 " "	.312	.25	.208	.166	.139	.125	.10	.083
7 " "	.276	.22	.183	.146	.122	.11	.088	.073
8 " "	.246	.20	.164	.131	.11	.10	.078	.065
9 " "	.223	.179	.149	.119	.099	.09	.071	.06
10 " "	.204	.163	.136	.108	.09	.081	.065	.054
12 " "	.174	.14	.116	.092	.077	.07	.055	.046
15 " "	.142	.114	.094	.076	.063	.057	.045	.038

THE PROPOSED 5,000 H. P. ALTERNATORS FOR NIAGARA.

THE latest number of the *Journal* of the English Institution of Electrical Engineers contains the illustrations accompanying the paper read by Prof. George Forbes before that body on "The Electrical Transmission of Power from Niagara Falls."[1] We give the illustrations of the machine characterized by Prof. Forbes as representative of the type to be employed at Niagara, together with the description.

On the bed-plate a vertical cylinder, A, Figs. 1 and 2, is bolted, with projections to support the fixed armature and the bearings of the revolving part. The armature coils, E and F, are wound independently, and can be removed and changed. They are fixed in slots, C, in the fixed armature. They are encased in an oil-tight casing through which oil can be circulated. The field magnet is external to the armature, and has the poles pointing radially inwards. It consists preferably of forged steel, supported by a spider, D, with eight arms, which may be of steel (shown as a bronze casting in the drawings) with a covering of thin sheet metal, on which cups are provided for forcing air into the interior of the machine. The pole-pieces are bolted on to the steel rim, B. The field coils are of copper strip, two coils being wound upon each pole, with a space between them for air circulation. The exciting current is applied by rings of tempered copper on the spider, having fixed brushes rubbing on them, shown at G. The hub of the spider is firmly fixed to the upper end of the shaft. The spider supports the heavy rim by 16 studs and nuts. The shaft is supported by two bearings, each of which has four radial arms, H, which are bolted to four corresponding projections on the cast-iron cylinder. This cast-iron cylinder is bolted to the bed-plate at I, and adjusted thereon by wedges. Besides having on it the projections for carrying the bearings on its inner side, it has on its outer periphery a series of vertical ribs, K, against which the stampings, or sheets of iron, forming the armature rest. It also supports the lower end plate, L, on which the armature is built up, and the armature is keyed to it by a single key. The armature is wound drum fashion —that is, all on the outside. This enables the coils to be wound independently and afterwards laid in their place, and also to be easily replaced in case of accident. In order to do this satisfactorily, the slots for each coil in the iron are cut, not radially, but parallel to each other, such as the two marked C in Fig. 2. Each coil is encased in insulating material, which forms a tube through which oil may flow as in a transformer, but may be forced, in which case its circulation is maintained by a pump. Round the base of the machine there are two oil pipes, A and B, one being the inlet, the other the outlet. These are seen in Fig. 3, which shows the improved oiling arrangements, which were worked out by Prof. Forbes' chief draughtsman at Niagara Falls, Mr. Baumann. The inlet pipe is connected with a reservoir of oil in the power house. The outlet pipe leads by another pipe to cooling arrangements in running water, from which the oil is pumped to the reservoir. From the inlet pipe 16 brass tubes, C, are led to the junction boxes at the bottom of the 16 coils; the 16 other brass tubes, D, are led from the junction boxes at the top of the coils, through the interior of the fixed armature, and bent over the foundation plate, and so connected to the outlet pipe which surrounds the bed-plate. The outlet pipe is broken at E, a cup being placed on the lower part to catch the oil as it issues from the upper part, so that the rate of flow of the oil may be seen. The bed-plate is a single iron casting, and, in order to enable it to be transported over the railways, it was necessary to limit its diameter, as shown in Fig. 3. The armature is built up of thin sheet iron, with ventilating spaces, as shown on the drawings. The bolts which hold the armature together are eight in number, made of nickel steel, a metal which has the great advantage of being non-magnetic, and of very high electrical resistance and great mechanical strength. The amount of nickel is 25 per cent.

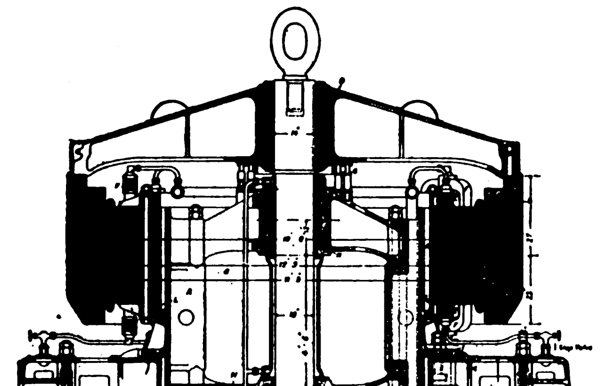


FIG. 1.

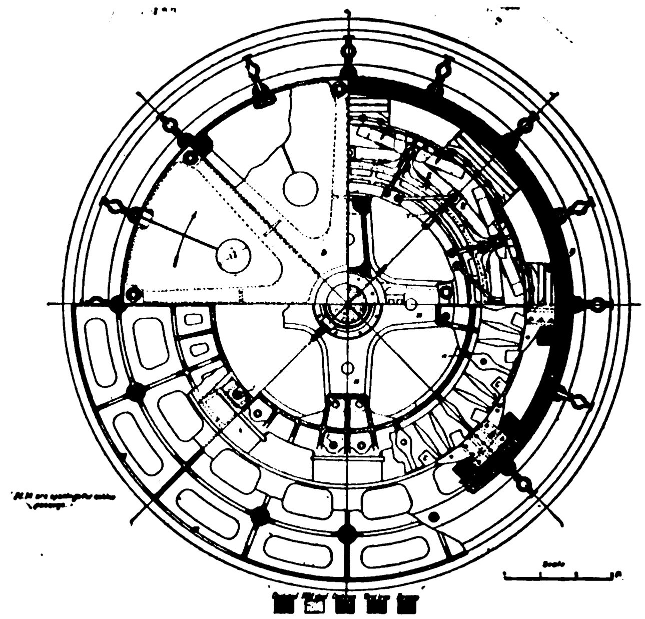


FIG. 2.

There are 16 armature coils, eight being of one kind, called "short" coils, and eight of another kind, called "long" coils, the length of wire on each coil being the same. The short coils are bent over on the top and bottom end plates, and the long coils are wound in one plane and enclose the short coils. This is clearly shown in the drawings, where the "short" coils are marked E and the "long" F. I find that if we are to have a very stiff field, with first-class quality of iron in the fields, each coil would consist of 72 turns of pure copper wire, No. 0 of the Brown & Sharpe gauge, which gives a very low density of current and reduces the heat.

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[1] See THE ELECTRICAL ENGINEER, Dec. 20, 1893, to Jan. 10, 1894, inclusive.

ing. In fact, it has been my view that, in designing the machines for so great and permanent a work, every effort should be made to reduce the rise in temperature, even to far below what has ever been done in the past. The unequal expansions and contractions of materials in a machine of this kind are very injurious to its permanence, and affect the insulating material seriously. The layers of wire in the coils are separated by mica. Each coil when wound has strips of insulating material laid spirally round it so that oil may circulate freely in the intervals, and the whole is encased in a casing of strong insulating material. The material which I prefer for this purpose is certainly Woodite, an eighth of inch of which will not break down with 30,000 volts, and which is not acted upon by oil even at high temperatures. I have a record of tests with oil which are conclusive on this point. It is quite the best material I have seen for the purpose, though costly, and being a secret process, it may be difficult to ensure uniformity.

The frames of the bearings are of cast iron, with four radial arms, which rest upon four projections cast on the vertical cylinder, and are bolted to them, as already stated. By this means, when the field magnet with the shaft has been lifted out of place, the bearings can be twisted through an angle of 45 degrees in a horizontal plane and then raised out of place, leaving a space 5 feet in diameter through which portions of the turbine shaft can be raised for repair. The bearings are oiled at the centre by oil forced under pressure through a pipe. The oil is then distributed over the bearings by spiral grooves. A spiral groove is also cut in the hub of the frame, with a pipe at each end to admit of water circulation to cool the bushing. At two opposite sides of each bearing the bushing is made thin, and a rod of bismuth is soldered thereto; so that if the bushing is heated a thermo-electric current shall be created which, by means of a relay, can ring a bell in the power house. When this occurs, water can be immediately admitted to cool the bearings, and the attention of the workmen is drawn to the necessity of an examination.

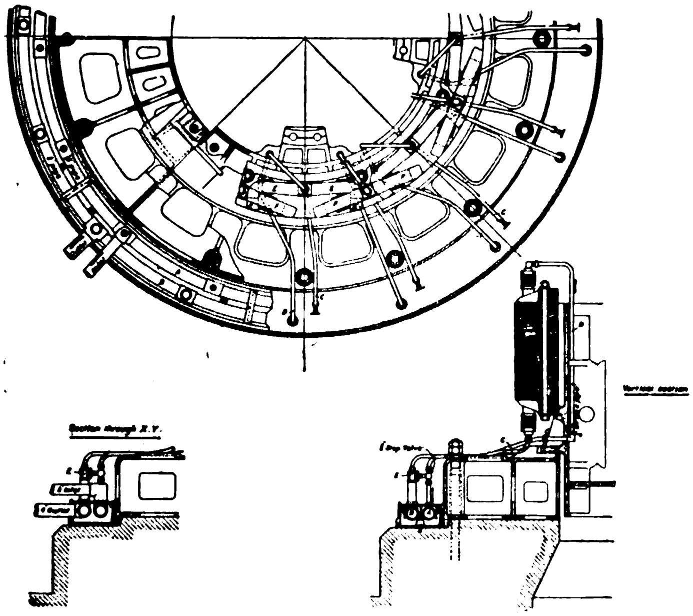

FIG. 3.

One of the parts which required most consideration was the material of which the spider supporting the field magnets should be constructed. The best plan is to make it of steel (although, as pointed out before, it is shown in the drawings as a bronze casting), for the sake of lightness, and to cover it with a copper covering, which might, I think, be spun; or, perhaps better, electro-deposited nickel might be used. Between the pole-pieces the space is filled up with a screen or plate of metal so as to direct the air ventilation only upon the parts which most require cooling.

COLLEGE NOTES.

COLUMBIA COLLEGE UNIVERSITY EXTENSION LECTURES.

A class in mathematics is about to be formed for the New York Electrical Workers. Mr. Max Osterberg who has laid out a plan of instruction will be in charge of the course. He intends to introduce the subject commencing with arithmetic and gradually lead up to algebra and geometry, giving as much as is necessary for an electrical worker to know, in order that he may deal intelligently with the problems that present themselves to him almost daily in connection with wiring, and other electrical work.

The formation of this class is due to the desire of many attending the course of lectures on practical electricity, delivered at Cooper Union, to become better acquainted with the phenomena of electrical science.

ELECTRICAL WORK AT COLUMBIA.

Although it is but comparatively recently that Columbia College has actively taken up instruction in electrical engineering the work it has already accomplished easily places it abreast of our best schools devoted to this branch. Columbia is, moreover, not confining its work and influence to the class room but is extending it far beyond as, for instance, by its admirable course of University Extension Lectures given in connection with the Cooper Union in which some of the foremost electricians in the country are taking part. In addition to this, a course of five lecturers on Electricity is being given at Yonkers.

The fourth course of lectures in New York will be devoted to "Electricity as a Factor in Modern Life," and will be given by Prof. Francis B. Crocker. The dates and titles of these lectures are as follows: March 6—The Dynamo and Electric Lighting. March 13—The Electric Motor and Transmission of Power. March 20—The Electric Railway. March 27—The Telegraph and Telephone.

The lectures which will be held at Cooper Union will be fully illustrated by experiments. No tickets of admission will be required and the doors will be closed promptly at 8 o'clock.

SOCIETY AND CLUB NOTES.

NEW YORK ELECTRICAL SOCIETY.—"THE ELECTRIC LIGHTING OF THE WORLD'S FAIR."

A lecture on the above subject will be delivered by Mr. Thomas Commerford Martin, at Columbia College, on Thusday, March 15, at 8 p. m., before the New York Electrical Society. The lecture will be profusely illustrated by lantern. In the collection of data and slides, Mr. Martin has had the active assistance of Mr. Luther Stieringer, who was the consulting electrical enginer of the Fair. Special attention will be given to night views of the Fair, exhibiting a wonderful advance in the photography of scenery and scenic effects after dark, and exemplifying the beauty of the electric light for spectacular purposes. Among the many points of interest to be treated in this original manner will be: The Electricity Building; The Tower of Light; Scenic Theatre; The Dome of the Horticultural Building; The Lagoons; Manufactures Building; The Big Search Light; The Fine Arts Building; Administration Building; The Grand Court of Honor; The Stieringer Electric Fountains; Effects Produced by Electric Illuminations, etc., etc. The scenes will be shown in contrast of daylight and night effect. Ladies are invited to this meeting of the Society.

LITERATURE.

The Practical Management of Dynamos and Motors. By Prof. F. B. Crocker and Dr. S. S. Wheeler with a chapter by H. A. Foster. Second Edition Revised and enlarged. *D. Van Nostrand Co.* Cloth 8vo. 205 pages, 99 cuts. Price $1.

In bringing out the second edition of their useful little treatise, Messrs. Crocker and Wheeler, with the help of Messrs. Dunn and Foster, have placed the profession under a real obligation. The book is now twice as large as before, and we are almost sorry it is not four times the size. Every page is freighted richly with valuable data, information, instruction and advice. The minutiæ is simply wonderful, and yet in breadth of treatment the book as a whole is hard to surpass. It its true that the work deals essentially with management, but by the time the reader has studied and mastered these pages, he ought to know as much about the machinery as its builders. Little remarks dropped quietly and casually here and there, open up wide, long vistas of thought, and explain many obscure points in construction; and one feels throughout the influence of very shrewd and observant minds. It is fortunate that the publishers issue the book in such compact form. It goes in the pocket and should always be there ready for consultation. We can only hope that every one of our readers will provide himself with a copy.

MR. H. DEARBORN GARDINER is well known in electrical circles by his clever pen-and-ink work illustrating articles that have appeared in THE ELECTRICAL ENGINEER, *Scribner's Magazine, Harper's Weekly*, etc. He has now placed on exhibition at the gallery of Sanchez & Co. 126 West 23rd street, New York City, from March 12 to March 22, a collection of seventy water color and black and white drawings of Spanish subjects. Mr. Gardiner has spent several years in Spain as art student and working artist, and these fruits of his work there form a delightful exposition of his skill.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.
Western Office, 1439 Monadnock Building, Chicago, Ill.
New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies, - - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

VOL. XVII. NEW YORK, MARCH 14, 1894. No. 306.

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A BIG OPENING FOR SMALL ARCS.

THOSE who follow carefully the signs of the times cannot fail to have noted unmistakable indications of an increased activity in the demand for arc lighting. Being the first form of illumination to arrive at a practical commercial stage it naturally received the undivided attention of inventors for several years before the incandescent light was reduced to practice, but since the advent of the latter it has been allowed to remain practically at a standstill. It had to give way before the mellow incandescent lamp, owing to the great facility of subdivision into units which could be placed exactly where wanted. The enormous importance of this ease of subdivision can be no better brought home to economists than by adverting to the well known fact that for the same amount of electrical energy expended the arc lamp produces 10 times as much illumination as the incandescent lamp, and yet the incandescent lamp has triumphed. With this condition of affairs confronting us it requires no great amount of discernment to predict that the next step towards improvement in arc lighting must be in the direction of arcs of small power, say from 50 c. p. up. We are aware that attempts at lamps of this character intended for general interior illumination have been made, more especially abroad, but even there their success has been very limited. Considering the perfection to which arc lamps have been brought at the present time, there seems to be but one thing which has up to the present militated against the use of such small power arcs, and that is the frequent necessity for renewing the carbons, not to speak of the cost of such renewal. The latter, however, in domestic installation, must be considered a matter of even less importance than the trouble of renewal.

If the view we have taken is correct then the public ought not to be allowed to wait long for the small arc. We base our hope in this matter on the results obtained with the Howard arc enclosing cylinder. Whatever may be the criticisms raised against this system as applied to lamps suspended out of doors they must of necessity fall to the ground when applied to lamps intended for in-door use. A close study of the situation forces the belief upon us that a thoroughly practical arc lamp of 100 candle power or thereabouts has a field before it as extensive as that of the incandescent lamp itself, and, indeed, it would not be difficult to predict its effect upon incandescent lighting as an industry The introduction of such a lamp however, need by no means create a panic in incandescent light circles. If we construe rightly the opinions expressed by the most advanced station managers, and confirmed by a number of those who took part in the discussions at the recent N. E. L. A. Convention in Washington, these managers have rightly begun to look upon their plants as electrical *power* generators as distinguished from *lighting* centres. Any method, therefore, which would enable the customer to obtain the most light for a given amount of money is the thing which the station manager will find to be the most profitable in the long run. Like the experience gone through by many upon the introduction of meters, the general introduction of arc lamps on incandescent circuits might be found to cut down the station output temporarily, but the revenue would be found to have increased. It is evident, therefore, that with the advantage on the side both of the customer and of the central station, nothing ought to stand in the way of the small arc. What can be done in the way of arc lighting on constant potential circuits is well shown in the 2,700 lamps now burning in Brooklyn, according to Mr. Barstow's report, with 400 more waiting to get on the circuit. From what has been said above it might be inferred by some that the days of the incandescent lamp are numbered, but such a conclusion would be, to say the least, very erroneous. The field is large enough for both and we have wished merely to point out a means of enlarging still further the scope of electric illumination. With that scope enlarged, the incandescent will be in greater demand than ever, but it will be reinforced and assisted by the small arc.

GROWTH OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

The representative character of such a body as the National Electric Light Association must be largely due, in the long run, to the support that it derives from the operating local companies. After such a successful and altogether delightful convention as that at Washington, no one will deny that the Association has already great strength and influence. In a manner not altogether uncommon, it has drawn sustenance from its troubles, and surviving a long series of conflicts and difficulties is to-day respected and valued throughout the country. Because of its work and its aims for the future, we think that local companies out of membership are not doing their duty to themselves or their fellows, and are debarring themselves from many opportunities of co-operation and usefulness.

As a matter of fact, the numerical strength of the Association is far below what it should be. Assuming as we may from the returns, that it embraces not less than 150 local companies in good standing, and that there are over 2,000 local electric light companies in the country, it will be seen that only about 7 per cent. of such companies are in membership. But the percentage should be much larger than that. The percentage of capitalization would probably come out far higher, but what is needed is the active participation of the medium sized companies, which have as a matter of course to be handled by a comparatively small executive staff and which can therefore best furnish and exchange valuable experience or data. It would, we think, be a good thing if Secretary Porter could devote a portion of each year to personal canvas of companies not in membership. It is our conviction that the results of such a campaign would be very gratifying.

We may mention as an item of information that the American Water Works Association has a membership of about 12½ per cent. of the possible, representing one-half of the invested capital. The American Street Railway Association has a membership of about 25 per cent., representing two-thirds of the invested capital. The latter instance is the more striking and encouraging of the two, and it is noteworthy that its membership is in no small degree electrical. An interesting feature of the recent Washington convention was the appearance of several visitors connected with electric street railway companies. The number is likely to grow, as the two interests of lighting and traction have many similar features already and are bound to have more. President Francisco who is of an eminently practical turn of mind, and fully alive to dangers that others have not seen so quickly, will, we venture to hope and believe, employ his term of office in rallying to the Association large numbers of the local companies to promote whose welfare it was established and for whom it may at no distant date have to perform vitally important service.

SHOULD ELECTRIC RAILWAYS SUPPLY POWER TO INDIVIDUALS?

In commenting last week on the work accomplished at the Washington Convention of the N. E. L. A., and referring to the new safe wiring rules adopted, by the Association, and their effect on future work of that character, we expressed approval of the rule prohibiting the introduction of railway circuits into buildings for power distribution purposes. Apropos of this, a correspondent writes to inquire why it is not just as fair for the railway company to sell power for light as for the electric light company to sell power to the electric railway company to operate its cars. Taking up the question of safety, first, we would reply that it must be apparent that to introduce a 500 volt ground return circuit into any building is inviting disaster and should be strenuously opposed by all having the true interests of the electrical industry at heart. While the question of personal safety does not enter here as a predominant factor, a shock from a 500 volt circuit is anything but pleasant, and with a grounded circuit the chances of attendants obtaining such amount to certainty. Looked at from the side of the danger from fire due to leaks from the circuits, there can be no two opinions as to the advisability of excluding such circuits from buildings. Even with a complete metallic circuit, we consider 500 volts direct current as too high for general indoor distribution, and hence we can find no reason for modifying our opinion on this matter. As regards the strictly ethical side of the question, there is of course no good reason why a railway company should not supply current for general power distribution, but where such work is contemplated, the power service to customers should be kept entirely distinct from that of the railway, so far at least as the electrical equipment is concerned. No better example of such combination stations could probably be found than that at Milwaukee which we describe in this issue, in which the feature of absolute separation of service is strictly adhered to.

A MODEL CENTRAL STATION.

In this issue we begin an exhaustive description of one of the best designed electric lighting and power plants which have thus far been erected in this country. The plant at Milwaukee may be looked upon as one of the forerunners of a class which is gradually finding general acceptance among electrical engineers and which presents a good object lesson in economical operation of lighting and power stations under one roof and one management. The station which Mr. Otto Frick describes is largely the design of Mr. J. C. Henderson and does credit both to him and to those who furnished the means to carry out his ideas. We shall be glad to have any of our readers who are interested offer their comments on any feature they may deem a fit subject for criticism.

MISCELLANEOUS.

POLYPHASE TRANSMISSION.[1]—I.

BY CHARLES F. SCOTT.

ALTERNATING CURRENT PROBLEMS.

WHEN alternating current was introduced for lighting it presented many new problems to the electrical engineer. Numerous difficulties and dangers were predicted by the theorist, but in ordinary service most of these have fortunately lain dormant. These difficulties are apt to appear, however, when alternating current work is attempted on a large scale. The introduction of large units, heavier currents, higher potentials or power service are apt to increase the effects of self-induction and capacity so that they will now demand careful consideration. The impetus which electrical engineering is receiving from the introduction of the polyphase system, which brings with it large units and long distances, naturally directs attention to the general problem of alternating current transmission and distribution.

A complete and exhaustive solution of this problem is by no means a simple one and the attempted solutions generally lead to formulæ and diagrams which are possibly even more perplexing than the phenomena. If even the electrician, who devotes all his energy to new problems, can scarcely keep abreast of the times, it is not surprising that the practical engineer and station manager become perplexed and confounded at the apparently erratic phenomena observed in practice or described in print. Theoretical articles appear on variation in wave form, harmonics, so-called Ferranti effects, increased resistance in conductors with alternating currents, hysteresis, peculiar magnetic currents, resonance, oscillations, lag, capacity, self-induction. Many of these articles, although evidently intended to be of service in engineering, show apparently no adequate appreciation of the practical bearing and relation of the subjects treated. Consequently the average engineer becomes bewildered and perplexed, and concludes that theoretical explanations are of little value to the practical man. There are, however, many points of great practical importance which admit of fairly simple statement and explanation. The particular element to be considered in the present paper is the transmission circuit.

EXPERIMENTS ILLUSTRATING SELF-INDUCTION.

One of the fundamental characteristics of alternating current working is self-induction. The effect of self-induction is most readily shown by a simple experiment. A wire having a resistance of 10 ohms may be wound in a coil. Ten volts will send a continuous current of one ampere through this coil. An alternating current of a certain frequency will require 50 volts for producing one ampere through the same wire (Fig. 1*a*.) In the diagrams the numbers above the circuit are for continuous current and those below are for alternating current. If a one ampere, 50 volt lamp be placed in series with the coil and a current of one ampere be passed through the two in series, the E. M. F. required for continuous current is 10 volts on the coil and 50 volts on the lamp, or 60 volts across the circuit, and the E. M. F. required for alternating current is 50 volts across the coil and 50 volts across the lamp, which gives, not 100 volts, but 78 volts measured across the two in series (Fig. 2). If two lamps be placed in multiple and connected in series with the coil, two amperes will require for continuous current 20 volts on the coil and 50 volts on the lamps, or 70 volts across the circuit. For alternating current, the E. M. F. on the coil is 100 volts and on the lamps 50 volts, and on the circuit across the two in series the E. M. F. is 120 volts (Fig. 3)

The two lamps which are in multiple may be placed in series with a second coil so proportioned that an E. M. F. of 50 volts will send one ampere alternating current through the combination, and a continuous current of one ampere would be caused by 35 volts. This combination may be treated as a unit and may be used to replace the single lamp in the above test. (Fig. 2.) If this combination be placed in series with the first coil, the E. M. F. required for sending the continuous current through the circuit will be 10 volts on the coil and 45 volts on the circuit. If the alternating current of 1 ampere be sent through the circuit, 50 volts will be required across the combination and 50 volts across the coil, the same as with the single lamp, but the E. M. F. across the circuit is no longer 78 volts, but has increased to 95 volts (Fig. 4).

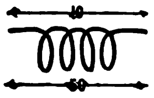

FIG. 1*a*.

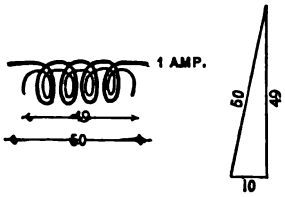

FIG. 1*b*.

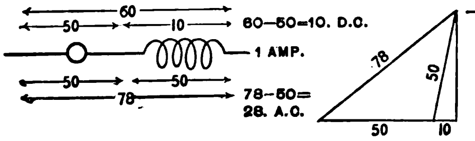

FIG. 2.

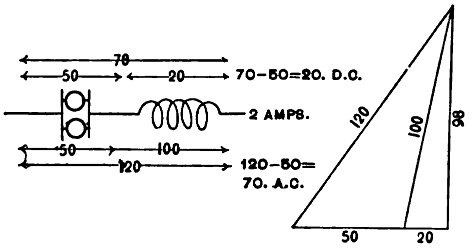

FIG. 3.

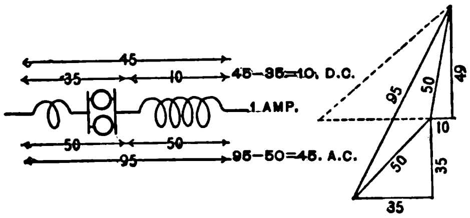

FIG. 4.

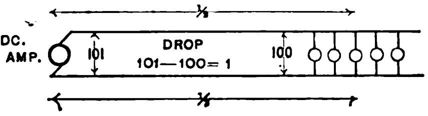

FIG. 5.

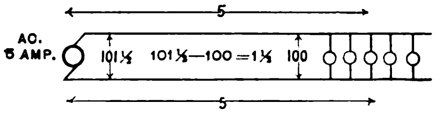

FIG. 6.

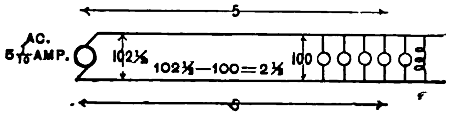

FIG. 7.

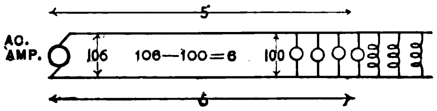

FIG. 8.

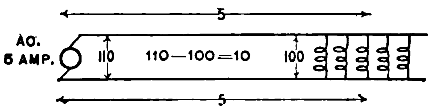

FIG. 9.

The important facts to be noted in these experiments are; (1) that the sum of the alternating E. M. F.'s on the elements in series is greater than that required on the terminals; (2) that the alternating E. M. F. for supplying the lamps in series with a coil is greater than the continuous E. M. F., and (3) that the difference between the two becomes greater as the number of lamps is increased (Figs. 2 and 3). It is also to be noted (4) that if the same alternating current be supplied through a coil, first to a lamp alone and then to a combination including lamps and a coil, a higher E. M. F. is required when the combination is used (Figs. 2 and 4).

These relations, which seem rather perplexing, may be illustrated in a very simple way by diagrams. In the case of the coil alone, in which 50 volts are required for producing one ampere alternating current and 10 volts for one ampere continuous current, these two E. M. F.'s may be represented by the hypothenuse and one side of the familiar right angle triangle. The remaining side represents the counter E. M. F. in the coil. If a second wire had been wound on this coil in parallel with the first it would be found that when one ampere is passing there is an E. M. F. on the terminals of the second, or idle, wire of 40 volts (Fig. 1*b*). This is caused by the field produced by the alternating current. An equal E. M. F. is of course induced in the wire carrying the current, as the two wires occupy virtually the same position. This counter E. M. F. is seen to correspond with the third side of the triangle. Suitable measurements would show that this counter E. M. F. occurs later than the current through the coil and that its maximum value occurs when the current is passing through its zero. This relation is shown in the diagram by the 90 degree relation of the lines representing counter E. M. F. and the volts required for sending continuous current through the line.

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[1] Paper read before National Electric Light Association, Washington, Feb. 27, 28 and March 1, 1894.

SELF INDUCTION IN CIRCUITS.

An ordinary circuit may be considered as a choke coil in which there is a single turn. The action in this case is very similar to that illustrated above with a coil of many turns. The effect of self-induction in a circuit may be most readily understood by some simple diagrams. A current of say 5 amperes is delivered at 100 volts over a circuit of ⅕ of an ohm resistance. The self-induction of the circuit is such that 5 amperes generates a counter E. M. F. of 10 volts. Both continuous and alternating currents are used and the generator E. M. F. is in each case adjusted to give 100 volts at the load.

The load consists first of five incandescent lamps. A coil of high self-induction is then added, which increases the current from 5 to 5.1 amperes. One of the lamps is then cut out and replaced by coils of such a self-induction as to give a total of 5 amperes. Then all of the lamps are cut out and coils substituted of such a number as to take 5 amperes at 100 volts. The E. M. F. required on the generator and the resulting drop, or difference of E. M. F. at the dynamo and at the load are given in the diagrams and in the following table:

	Continuous Current.	Alternating Current.			
	Fig. 5.	Fig. 6.	Fig. 7.	Fig. 8.	Fig. 9.
Current in line	5	5	5.1	5	5
" " lamps	5	5	5	4	0
" " coils	0	0	1	3	5
E. M. F. on load	100	100	100	100	100
" " line	1	10	10	10	10
" " generator	101	101.5	102.5	106	110
Drop—total	1	1.5	2.5	6	10

It is to be noted that with exactly the same circuit for supplying five lamps with the same amperes at the same E. M. F., there is an increase of drop between generator and load when continuous current is replaced by alternating current. This drop is much less than the volts required for sending the alternating current through the line, and it moreover increases enormously as the load becomes even slightly inductive. Thus when the current is increased only two per cent. (from 5 to 5.1 amperes, Figs. 6 and 7) by the addition of inductive load to the lamp load, the increase of drop due to self-induction is increased from ½ per cent. to 1½ per cent. or a threefold increase. When the load consists of four lamps and coils are added in multiple to take a total of 5 amperes, or the same as that taken by the five lamps from the generator, the drop is four times the drop when five lamps alone are in circuit; Fig. 8. If the remaining four lamps be replaced by coils, Fig. 9, the drop increases from 6 to only 10 per cent. The effect therefore of a slight self-induction in the load causes a much greater proportional drop than the presence of a large self-induction. A counter E. M. F. of 10 per cent. is not at all likely to occur in a 100 volt line carrying a small current. The figures given, however, serve as an illustration of the percentage variations which are liable to occur in other parts of the system.

DROP IN CONTINUOUS AND ALTERNATING CIRCUITS.

The word "drop" in continuous current calculations has a perfectly well defined meaning. In the case of the five lamps which take 5 amperes at 100 volts through a circuit of one-fifth of an ohm, as illustrated in Fig. 5, the drop is (1), the difference between the E. M. F. at the generator and at the lamps, or (1) volt, which is one per cent; (2) it is the E. M. F. required for sending the current through the line. This is equal to the current multiplied by the resistance, and is the E. M. F. which would be required for sending the current through the line if the load were short circuited; (3) a drop of one per cent. means also that the energy lost in the line is one per cent. of that delivered by the generator; (4) a loss of one per cent. in the line also signifies that the energy delivered is one per cent. less than that supplied by the generator.

In alternating current work the same uniformity does not exist; for example, in the experiments with the same five lamps and the same line, (1) the generator pressure was 101½ volts, or ½ per cent higher than that of the lamps; (2) the E. M. F. required for sending a current through a line short circuited is 10 volts, or 10 per cent.; (3) the energy lost in the wires is C^2 R, or five watts, which is one per cent. of the energy when five lamps are supplied. If four lamps and low resistance coils are connected to the circuit, the energy delivered is, say, 400 watts and the loss is 1¼ per cent.; (4) if the coils alone are supplied and their combined resistance is equal to that of the circuit, or one-fifth of an ohm, then the losses in load and line are equal, and the actual line loss is 50 per cent. The apparent energy at the generator is 550 watts (110 volts and 5 amperes) and the apparent energy delivered is 500 watts (100 volts and 5 amperes) so that the apparent line loss is 9 per cent.

It is therefore evident that the several elements commonly referred to as drop or per cent. loss with continuous current are so modified when alternating current is used that it is possible for no two of them to have the same value. Moreover, with alternating current none of these elements may have the same per cent. value as that for continuous current on the same circuit (Figs. 10 and 11.)

LOSS AND REGULATION.

The two vital factors in the line are loss and regulation. The losses are C^2 R and should be expressed in watts or horse power, or as a per cent. of the energy delivered to the line. The practical point in regulation is the difference in E. M. F. at the generator and at the load. When these two factors are known it is generally immaterial what E. M. F. might be required for sending current through a short circuited line. The word "drop" is applied to the difference in E. M. F. between the generator and the load. The regulation is generally expressed in per cent. of generator E. M. F. but in this paper the E. M. F. at the load will be considered 100 per cent., as this is the element to be kept constant, while the E. M. F. of the generator is variable, depending upon the load and other elements. The regulation, or drop, in the alternating current circuit is dependent largely upon the counter E. M. F. of the line. The factors which practically determine the counter E. M. F. of the line are size of wire, distance between wires, length of circuits, frequency and current. Mr. A. E. Kennelly has given very complete curves[2] for determining the impedance of pole lines. The impedance factors given may be used for finding the current through a given line which is short circuited at one end, when the E. M. F. and frequency are known. The impedance factor of the line for supplying five lamps described above is 10, as the alternating E. M. F. is ten times the continuous E. M. F. for the same current when the line is short circuited. The word "drop" is applied in Mr. Kennelly's article to the volts required for overcoming impedance in a circuit, and the impression that this is the same as the drop in continuous current circuits was not corrected in the paper, nor was this most practical point raised in the discussion. The relation between impedance and loss was, however, demonstrated mathematically in a communication after the meeting. The figures given in connection with the foregoing diagrams show very clearly that a circuit having the same impedance may have a drop between the generator and the load of from 1½ to 10 per cent., depending upon the character of the load. Impedance therefore does not determine regulation.

CALCULATION OF DROP IN ALTERNATING CIRCUITS.

The regulation of a circuit is in general determined by two elements; the counter E. M. F. of the circuit and the self-induction of the load. The counter E. M. F. of a line depends upon the size of wire and the distance between wires, and increases directly as the length of the circuit, the current and the alternations. The counter E. M. F. of a line has been calculated for a number of cases which are likely to occur in practice and the results are given in Fig. 2. The drop, or difference of potential between generator terminals and the load terminals due to the counter E. M. F. of the line depends, as has been shown, upon the self-induction of the load. The latter is best expressed by a power factor or a factor by which the product of the amperes and volts giving the apparent energy must be multiplied to give the true power in watts. The power factor for incandescent lamps is 1.00, or the apparent energy is equal to the true energy. The power factor for converters loaded with incandescent lamps is usually over .99. The factor for unloaded converters varies from .50 to .80 and in open magnetic circuit converters, notably the "hedgehog," the factor may be as low as .05. The drop due to self-induction on the line (which, plus the ohmic drop, will give approximately the total drop) corresponding to various power factors of the load is given in Figs. 12a and 12b. The curves show that if the power factor be 100 per cent., as it is with incandescent lamps, the inductive drops for various counter or inductive E. M. F.'s are .02 per cent for 2 per cent.; .08 per cent. for 4 per cent.; .18 per cent. for 6 per cent.; .32 per cent. for 8 per cent.; .5 per cent. for 10 per cent.; 1.2 per cent. for 15 per cent.; and 2.0 per cent. for 30 per cent. The curves show that the drop increases very rapidly at first if the power factor becomes less.

These relations may be elegantly determined by a simple diagram on section paper ruled in tenths. Draw an arc through a quadrant with a radius of 100. At a distance from the centre on the horizontal, equal to the power factor of the load, erect a perpendicular and extend it to the arc. This line represents the counter E. M. F. of its load and its value read directly on the scale gives the counter E. M. F. in per cent. of the E. M. F. upon the load. From the intersection of the arc draw a horizontal line outside the circle equal on the scale divisions to the per cent. in terms of the E. M. F. on the load which would be required for sending the normal amperes continuous current through the line resistance. From the end of this horizontal line draw an upward vertical equal to the counter E. M. F. of the line expressed in per cent. of the E. M. F. on the load. A line from the centre to the upper end of this vertical represents in direction and magnitude the E. M. F.

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[2] *Transactions* American Institute of Electrical Engineers, April, 1893.

which must be impressed on the circuit. If from the same centre an arc be drawn through this point to the base, the scale divisions on the base between the two arcs measures the total drop caused by the lines in terms of the E. M. F. on the load. (Fig. 10.)

SELF-INDUCTION IN TRANSFORMERS, ETC.

Self-induction exists in line, generators, transformers, secondary wiring, and sometimes in the load. In each case the effect of the self-induction upon regulation depends largely upon the self-induction of the total load which it supplies. Thus, the regulation of a generator depends upon the total self-induction of the line, transformers and load. Again, the regulation of a line supplying converters depends both upon the self-induction of the converters as well as that of the useful load. The same analysis, diagrams and tables which have been used above in connection with the line will apply to the transformers and approximately to the regulation of the generator.

An ordinary transformer has a primary self-induction, a secondary self-induction and a mutual induction, which becomes a ready source of a very complicated and perplexing analysis when the complete action is described in theoretical terms. Practically, however, the action of the self-induction in the transformer may be expressed in a very simple way, and it is readily seen that this self-induction has a very important bearing upon the regulation of the transformer. The regulation of the transformer is very similar to that of a line, as explained above. If the secondary coil be short-circuited the E. M. F. on the primary may be adjusted so that the normal full load current passes through the apparatus. This E. M. F. corresponds very closely to the E. M. F. required for sending current through a short circuited line and in ordinary transformers is practically equal to the counter E. M. F. and may be considered equal to it.

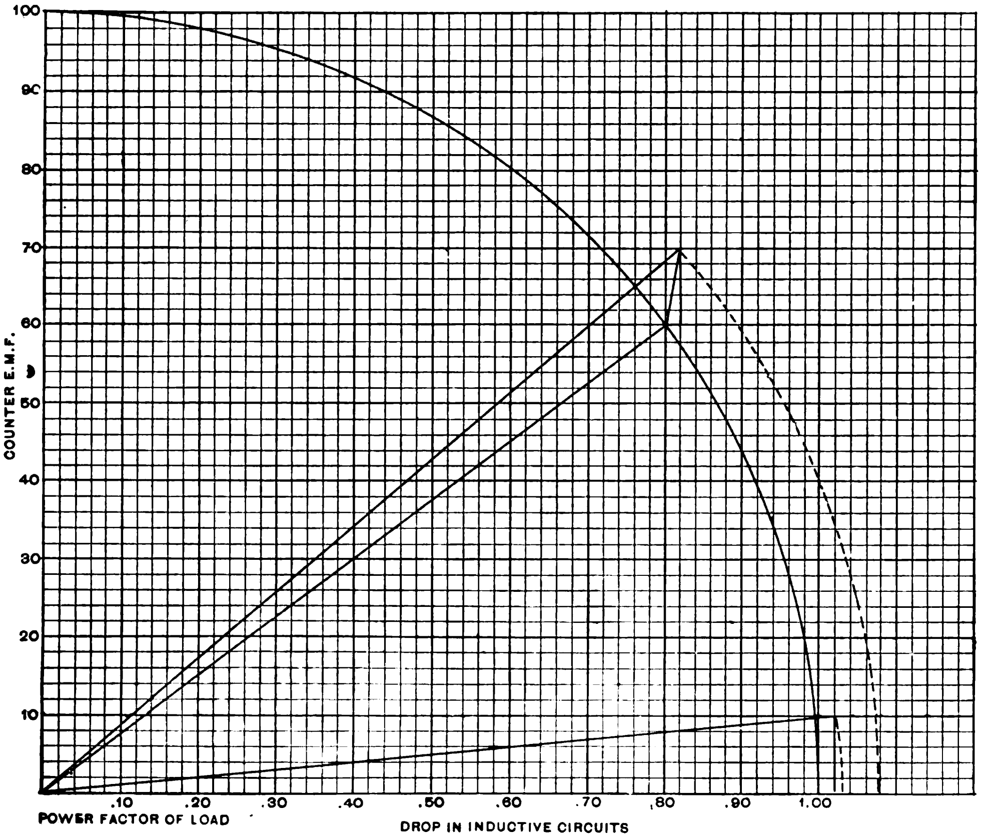


FIG. 10.

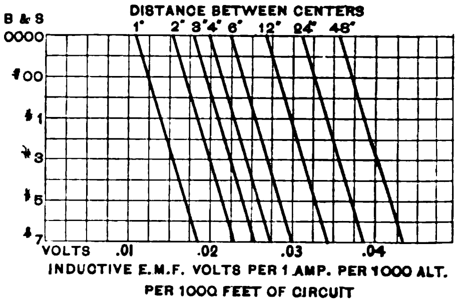


FIG. 11.

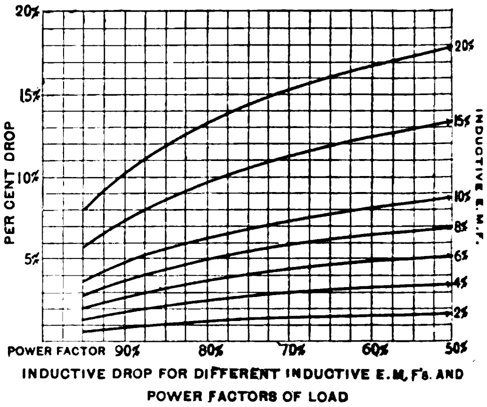


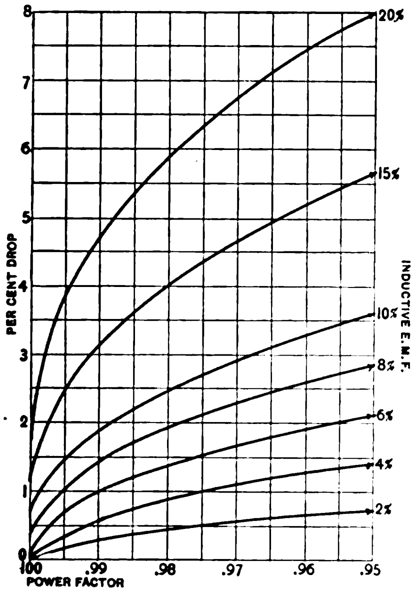
FIG. 12*a*.

A transformer may be taken for experiment in which the E. M. F.'s are 1,000 volts and 100 volts. If 5 volts, or ½ per cent. is required for sending through the primary a continuous current equal to the normal full load current of the transformer, and if a similar E. M. F. in the secondary is ½ volt, or ½ per cent. then the ohmic loss to the transformer is one per cent. and the drop in pressure at the secondary terminals between no load and full load will be one per cent. of the self-induction be negligible. If, however, there is a self-induction so that 100 volts, or 10 per cent. is required for sending the normal current through the primary when the secondary is short circuited, then the drop in pressure is in general greater than one per cent. depending principally upon the character of the load. The load may be non-inductive, as lamps, or it may be more or less inductive. The experiments described above, in which a line had the same per cent. ohmic and inductive characteristics as the converter just described apply to the converter as well as to the line. The drop on such a converter therefore may vary from 1½ to 10 per cent. when delivering its rated current. Arc lamps or fan motors will produce a very much greater drop than incandescent lamps. The power factor of an alternating current arc lamp varies considerably, but in a number of cases has been found between 85 and 90 per cent. The drop when incandescent lamps are replaced by arc lamps on the transformer just described increases from about 1½ to 5 or 6 per cent.

A secondary line, if it carry a large current, may have a counter E. M. F. of several volts. This may not be enough to increase appreciably the drop in the line between the transformer terminals and incandescent lamps. The transformer, however, delivers current to the secondary circuit and to the lamps, so that the regulation of the transformer may be affected by the self-induction of the secondary circuit. Cases have occurred in which transformers of a very old type possessing high self-induction were supplying very large secondary currents and the resulting drop in the transformers was increased several per cent. For example, a circuit of No. 0000 B. & S. wire supplying 100 amperes to 50 volt lamps at a distance of 100 feet has an ohmic drop of 2 per cent. The constant for counter E. M. F. of this circuit, if the wires be 6 inches apart, is .022. The volts at 16,000 alternations are .022 × 100 × .1 × 16 = 3.52, or 7 per cent. of 50 volts. The inductive drop in the line corresponding to 7 per cent. is .25 per cent. The power factor of the aggregate service of the transformer is the second side of a right angle triangle of which 7 is one side and 100 is the hypothenuse. This is 99.7, which is the power factor of the total load on the transformer. If the self-induction of the converter be 10 per cent., the inductive drop is 1.2 per cent.; if 20 per cent. the inductive drop is 3.4 per cent. and if 80 per cent, the inductive drop is 7 per cent. The aggregate drop in the converter and secondary circuit in the latter case would be, say, 2 per cent. for ohmic drop in transformer, 2 per cent. ohmic drop in line, 7 per cent. inductive drop in transformer and .25 per cent. inductive drop in line, or a total of 11.25 per cent. The necessary ohmic drop is 4 per cent. and the inductive drop resulting from self-induction in traneformer and line is therefore 7.25 per cent. If the number of alternations be reduced to 7,200 the inductive drop would be reduced from 7.25 per cent. to 1½ per cent.

ORDINARY TESTS UPON TRANSFORMERS.

The practical bearing of the self-induction of a transformer upon its regulation and the exact relation between the two does not seem to be clearly recognized, and even Dr. Hopkinson and Dr. Fleming, who have made very exhaustive tests upon transformers, comparing different methods of testing and different types of transformers, have not brought out this point. Attention is given to the exact form of the current wave, and measurements upon the iron losses are attempted within very close limits of error. Their measurements upon the regulation of the same transformer, however, vary from 2 per cent. to 2.4 per cent. or one measurement is one-fifth greater than the other. The presence of a light induction in the secondary load would have caused a very considerable increase, and it is probable that the difference in the measurements made were due to difference in the self-induction in the instruments used or in the load at the time the tests were made. No note is made of the effect of the self-induction of the load upon regulation, although regulation is one of the most vital points in the practical use of transformers Even the temperature at which the drop was measured is not stated, although the resistance of a transformer when continuously working may be 20 per cent. greater then when cold. The elements of practical importance in a transformer are (1) the iron loss, in respect to the efficiency; (2) in the regulation, in respect to the satisfaction of service, and (3) the temperature to which the insulation is subjected, as affecting the life of the transformer. In the ordinary tests by theoretical men, the iron loss is measured to a very high degree of refinement, although the iron loss in transformers is the one thing which cannot be controlled, and is certain to vary 10 to 15 per cent. in commercial manufacture of transformers of the same size. The wave form of E. M. F. on different dynamos or the difference in form under different conditions of load on a circuit may make the loss under different commercial conditions vary several per cent. This renders more refined measurements of no practical use unless the conditions are stated. The temperature of the iron also affects the loss. The full load efficiency is usually given as if it had a great deal of importance, whereas the losses in copper during 24 hours ordinarily amount to but a trifling per cent. of the total losses. The regulation, and the temperature to which the insulation is subjected and which it is able to stand are generally not mentioned in reports of tests. The usual investigations and the papers published on the alternating current transformer may perhaps accurately express many facts in complicated formulæ, but the practical bearing of these points in every-day working seems to be totally ignored.



INDUCTIVE DROP FOR DIFFERENT INDUCTIVE E.M.F's. AND POWER FACTORS OF LOAD

FIG. 12b.

Lighting the West Side Tunnels.—The direct coupled Waddell-Entz generators on McEwen engines and a portion of the fifty Nutting arc lamps ordered some time ago for lighting the new tunnel of the West Chicago Street Railway, have been started and are now in daily operation furnishing light for laying the cable tracks through the tunnel. The arc lamps are run two in series from the 110 volt constant potential circuit. This tunnel is said to be the second largest in size in the world, as regards diameter. The entire plant is expected to be in operation within a month, and as the conditions under which the apparatus has to operate, will be unusually severe, the performance of the plant will be watched with much interest by all electrical engineers as well as others interested.

LEGAL NOTES.

NO TERRITORIAL RESTRICTION ON EDISON LAMPS RIGHTFULLY ACQUIRED.—EDISON ELECTRIC LIGHT CO. vs. ROBERT STAFFORD et al (THE IMPERIAL HOTEL, NEW YORK).

Last year the General Electric Co., secured a decree enjoining the proprietors of the Imperial Hotel in New York from using other than Edison lamps. The proprietors of the hotel thereupon obtained Edison lamps, but not from the New York Edison Electric Illuminating Co., the Edison licensee for New York City below 70th street. The General Electric Co., then moved to punish the proprietors of the Imperial Hotel for contempt. Judge Lacomb of the U. S. Circuit Court has just handed down a second memorandum denying the motion, and holding that the Imperial Hotel had the right to procure Edison lamps from any source it desired. We give the text of the memorandum below:

Lacombe, C. J.:—The additional affidavits show that the lamps of the Edison pattern used by defendants have been obtained by them by purchase from three sources. 1. McLeod, Ward & Co. dealers in electrical supplies in the City. 2. The Jaynes Electric Co., a copartnership in Buffalo dealing in such supplies. 3. The F. P. Little Electric Construction & Supply Co., also in Buffalo.

1. The first-named firm bought the lamps from the Edison General Electric Co., and its successors the General Electric Company, exclusive licensees to manufacture under the patent. McLeod prior to such purchase had signed an agreement binding his firm not to sell any of the lamps so bought in violation of the various obligations which existed between the company and its licensees, and further agreed to keep himself informed of such obligations. The lamps in question were bought from the Edison Company upon an order of the firm, stating that they were "for use above 70th Street." They were sold to defendants by McLeod without restriction.

2. The Jaynes Electric Co. bought the lamps it sold to defendants from the Buffalo General Electric Company. This corporation obtained them from the General Electric Company, under a contract which authorized it to sell such lamps only to users of lamps within the County of Erie, except Tonawanda. The Jaynes Company bought the lamps from the Buffalo Company without restrictions, and sold them to defendants in like manner.

3. The F. P. Little Company bought the lamps it sold to defendants from the General Electric Co. through its Syracuse agent. It had previously signed an agreement similar to that executed by McLeod, but in making the sale to the defendants imposed no restrictions.

No doubt the defendants were advised in a general way that the complainant the Illuminating Company claimed that it had the sole right to use, and sell for use, lamps of the patent within the City of New York, but there is no reason for discrediting their statements that as to these particular lamps they had no notice or knowledge of any restrictions placed upon those who sold them.

Under these circumstances I am of the opinion that under the principles laid down in *Adams* v. *Burke*, 17 Wall 453 and *Hobbie* v. *Jennison*, 149 U. S. 355, the defendants have the right to use the lamps they bought anywhere in the United States. Concededly they were made by the General Electric Company, the exclusive licensee under the patent, and were sold by it to persons to whom it had the right to sell. The last-cited case reiterates the proposition that the "sale of a patented article by an assignee within his territory carried the right to use it everywhere." * * "*Once lawfully made and sold* there was no restriction on the *use* to be implied. for the benefit of the patentee or his assignees or licensees." The dissentients in *Adams* v. *Burke* and many Circuit Judges in subsequent decisions clearly and forcibly pointed out the result of such a construction of the patent laws, as would leave a patentee, who wishes to divide his rights territorially, dependent upon the good faith of those to whom he sells. But the Supreme Court has so held, and there is nothing for this Court to do but to conform to such decision. The patentee's remedy is against those who. after binding themselves to conform to his restrictions, have violated their agreements. He may protect himself either by selling his lamps only to persons on whose honesty and responsibility he can rely, or by requiring from them sufficient security, that they will respond for any damages he may sustain by their failure to keep faith with him. The purchaser of lamps once sold by the patentee, or the person whom he authorizes to make and sell them, cannot under the decisions *supra*, be charged with knowledge of the restrictions upon re-sale which are matter of agreement between the patentee or the licensed manufacturer and the first purchaser.

Motion to punish for contempt is denied.

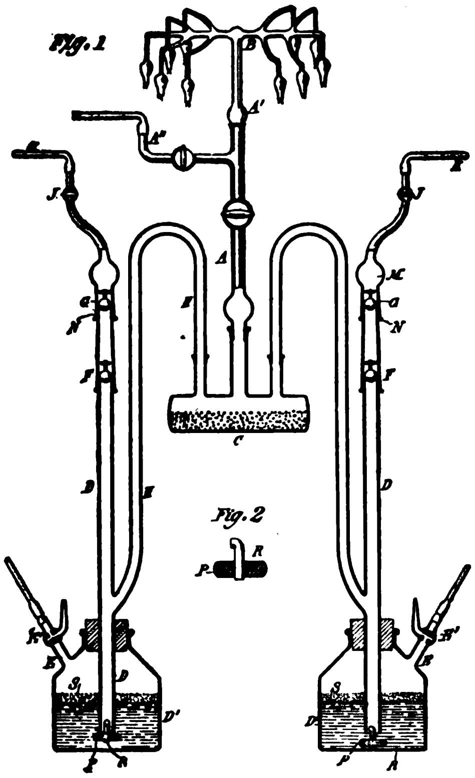
METER INSPECTION IN CANADA.

At the instance of some of the principal electric light companies, the Canadian Government has decided to establish a system of inspection of electric meters similar to that already in force for gas meters. A bill for this purpose is to be introduced in Parliament at the approaching session.

THE ASHWELL AND VANDERGRIFT "TUBULAR" MERCURY PUMP.

THE manufacture of incandescent lamps has greatly stimulated the study of, and given rise to numerous modifications in, the mercury pumps for exhausting the lamps, but it would seem that there was still room for improvement when it is considered that with the best Geissler pumps in use in one of our largest lamp factories it is necessary to keep the lamps on the pumps for three hours, and this even with the aid of mechanical pumps which remove the greater part of the air to begin with. It is evident therefore that if the time required for exhaustion could be reduced, the cost of the equipment and the operation of a lamp factory could be correspondingly reduced. It was with this idea in view that Mr. R. P. Ashwell, of Newark, N. J., and Mr. James A. Vandergrift, of New York, undertook to devise a mercury pump which should operate faster and hence cheaper than the present forms, and their long experience in the lamp works of the Sawyer-Man Electric Co. has greatly aided them in the solution of the problem.

The principle of the pump, which is of the Geissler type, will be readily understood by reference to the accompanying illustrations. Here A is a vertical tube with a ground orifice A' into which the stem of a cluster of lamps B, which are to be exhausted, is fitted. The tube A has a branch A'' through which the preliminary exhaustion of the lamps and the interior of the pump is effected by a mechanical or power pump. The high vacuum or mercury pumps are connected with the tube A through the usual receptacle C for an anhydrous absorbent. As both of the mercury pumps are of the same construction, a description of one will suffice for both.



FIGS. 1 AND 2.—THE ASHWELL AND VANDERGRIFT "TUBULAR" MERCURY PUMP.

D is a vertical tube the lower end of which extends down into a mercury reservoir D' through an air-tight seal. From the upper part of the reservoir D' runs a tube E divided into two branches, one connected with the mechanical exhaust pump, the other open to the air. These branches are controlled by a three-way cock E'. The interior of the tube D is of as nearly as possible uniform diameter to its upper end, which is contracted and connected by a tube K with a mechanical exhaust pump. A cock J is placed in the contracted portion of the pipe D at a point somewhat more than thirty inches above the lowest level of the mercury in the reservoir D', and below the cock and in the uncontracted portion of the tube D are two automatic valves F G. At a point slightly above the reservoir D' the tube D is branched, and connected by an inverted U-shaped tube H with the receptacle C. The highest point in tube H is somewhat over thirty inches above the line of lowest normal level of the mercury in the reservoir D', or a little above the highest level to which the mercury rises in the tube D.

By the mechanical or power pump the air is partially exhausted from the interior of the apparatus through the tubes A'' and K. Air is then admitted into the reservoir D' above the mercury which causes the latter to rise in tube D. When its level reaches the branch to tube H, a certain portion of the residual air is intercepted in the upper part of tube D and is forced by the rising column of mercury up through the valves F and G into the exhausted chamber to which the pipe K is connected. The mercury flows up around the valves F and G, rising until the air bubble is properly expelled, and at the same time flows up in tube H to a point sufficiently below the bend to prevent its passing over into the receptacle C.

While this operation is taking place in one of the pumps the reverse occurs in the other. That is to say, the air is exhausted from the reservoir D' by the mechanical pump so that under the more nearly equal pressures the mercury descends from the pump and flows back into the reservoir D'. The valves F G are loaded so that they seat themselves when only sufficient mercury is left above them to partially cover them. These actions go on alternately until the desired degree of exhaustion is attained.

In order to secure the best and most rapid operation of the pump it is necessary to carry out the feature of uniform diameter of tube D to the extent of so constructing the valves F and G that there will be a practically unobstructed passage for the mercury through them, and for this purpose, instead of seating these valves in contracted portions of the tube, the valve chamber M, or that portion of the tube containing the valve, is made with a ground opening which fits over the ground end N of the section of tube below it and seat the valve directly upon the open end N. The tubes are not contracted at all, or at least to any material extent.

Inasmuch as the tube D affords a free and unobstructed passage to the mercury, the too sudden or accidental admission of air to the reservoir D' would cause the mercury to rush up the tube D and through the valves F G with considerable violence. It is therefore necessary to check the flow of mercury from the reservoir into the tube D. But it is desirable that the return of the mercury should be free and unobstructed; hence between the reservoir and the tube there is interposed a rubber washer P, shown enlarged in Fig. 2, through which extends a contracted glass tube R, the upper end of which is bent over to prevent the mercury from squirting up into the tube. This prevents too rapid a flow of mercury into the tube but allows it to return freely back into the reservoir by lifting the valve bodily away from the end of tube D which forms its seat.

In these pumps it has been usual to pass the air admitted to the mercury reservoir through some material that would absorb the moisture contained therein, but this has not proved altogether effective. Messrs. Ashwell and Vandergrift find that they can secure very much better results by placing on the mercury within the chamber an absorbent S, that will float on the mercury. In this way the mercury is fully protected from direct contact with the inflowing air, and as the mercury flows back from tube D it surges up through the absorbent and is thoroughly dried.

In the pump as designed for regular service the tube D is 2 inches in diameter and with the duplex arrangement shown, 20 lamps can be exhausted in 20 minutes, the pump making easily no less than 8 strokes per minute.

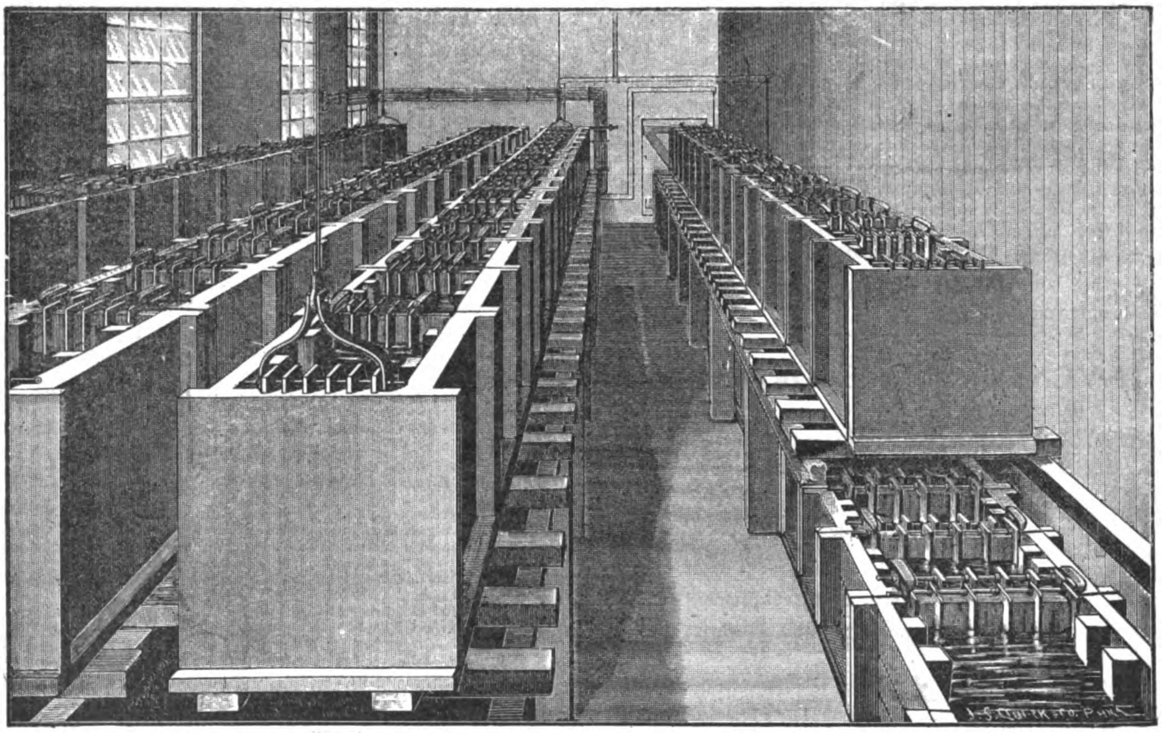
It is evident that with such a rapid pump the a large reduction in the equipment and cost of manufacture can be effected and calculations based on actual results already attained shows that the number of pumps, capacity of engine, boiler and dynamo and floor space occupied can be reduced to one-fifth that required by the present style of pump employed. When it is considered that the pump department often occupies 80 per cent. of the space in a lamp factory and that the power required in the pump department bears a like ratio to the total required, the saving which can be effected is obvious. We may add that the new pump has been recently patented.

ACCUMULATORS IN CENTRAL STATIONS.

THE accompanying illustration shows a storage battery installation made by The Electric Storage Battery Company at the station of the Germantown Electric Light Company, of Philadelphia. This battery consists of one hundred and twenty elements of the Chloride Type G, eleven plates each. They are installed on the three-wire system, and have a normal discharge rate of one hundred amperes on each side, and a capacity at this rate of 2,000 ampere hours. The plates are protected by the improved asbestos insulation, and are contained in lead-lined wooden tanks set on glass insulators, and supported on strong stands, painted with acid-proof paint, in four rows of two tiers each.

The special application of a battery in this instance is for the purpose of carrying the day load of the station for the commercial lighting and power circuit. The engines are shut down at daylight and the battery carries the whole load until dusk, at which time it is thrown out of circuit, and is put into charge during the early morning hours, when the station load is light, and the cost of charging is practically nothing, as the machinery is more efficient, no extra labor being required during charge, and during discharge the working force of the station is considerably reduced, the battery requiring practically no attention. The potential is maintained in discharge by the cutting in or out of reserve cells, six of which are used on each side. The Germantown Electric Light Company, after over a year's experience with the chloride battery have thoroughly demonstrated the advantages claimed for a storage battery for central station purposes. In view of the large number of electric light stations in this country, which are to-day either running a day load at a loss or else furnishing no current at all during the daytime, the importance of demonstrating the advantages of applications of this character is clearly apparent, since a battery in such stations will often not only wipe out the loss, but show a profit, and enable the lighting company to furnish continuous service.

By the installing of a storage plant many small natural sources of power may be utilized in furnishing light and power; sources which otherwise are not available, because not large enough to supply maximum demands. The force of the tides of small water powers from irrigating ditches, and even of the wind, come under this head. To all of these applications the chloride accumulator is particularly adapted because of its enormous storing capacity and demonstrated durability and efficiency. In Paris, alone there are over 100,000 electric lamps supplied by chloride accumulators, as well as a large amount of electric power.



Chloride Accumulator Plant in the Germantown (Pa.) Electric Light Co.'s Station.

The chloride accumulator is built of any desired capacity by The Electric Storage Battery Company, of Philadelphia, who guarantee its operation as regards capacity, efficiency and cost of maintenance.

Letters to the Editor.

MORE ABOUT THE CHLORIDE ACCUMULATOR.

I have read the letter of Mr. Gibbs, President of the Electric Storage Battery Co., in your issue of this week.

Feeling that yourself and the public may be interested in getting the true facts in relation to the decision by the Court of Appeals in France sustaining the Faure patent, I ask to be permitted to once more trespass on your space in order to make clear what Mr. Gibbs endeavors to befog by the most specious casuistry, by stating that the price which Baron Rothschild paid for the French Faure patent was merely a "nominal consideration," and secondly, by endeavoring to make the reader of his letter think that the decision in France did not affect his battery. Now, the fact is, that the decision in France was directly to the point that the Chloride battery is an infringement of the Faure patent, and that the force of that decision was so strong against the Chloride Company that Baron Rothschild had to buy a controlling interest in the Faure Company, paying therefor 1,350,000 francs, besides the debts of the Faure Company. This sum may appear to Mr. Gibbs, whose Company is capitalized at $10,000,000, as a "nominal consideration."

The battery which was enjoined by the French decision is substantially similar to the Chloride accumulator, and in *no way* resembles the description which Mr. Gibbs' fancy attaches to it. It was the Pollak battery. To a lead support was applied sulphate of lead and chloride of sodium; Mr. Gibbs' company applies to a lead support chloride of lead and chloride of zinc. Pollak immersed his plate in a bath of chloride of sodium, containing a slab of metallic zinc, for the purpose of reducing the matter adapted to become active to spongy lead; Mr. Gibbs immerses his plate in a bath of chloride of zinc, in connection with a slab of metallic zinc, in order to reduce the matter adapted to become active to spongy lead; so that we have in each case salts of lead applied to a lead support, in each case immersed in an equivalent bath with a metallic zinc slab, for the same purpose, to-wit, to reduce the active matter to spongy lead. The Court of Appeals of France held that the Faure invention covered salts of lead as well as oxide of lead, and that Pollak could not escape infringement by the double process above described. The Court says that the first process was but a preparation of the plates, and the moment the two plates were combined in the acidulated electrolyte, Pollak became an infringer of the Faure invention.

A copy of the decision can be seen at my office; also my authority for the statement of the payment which Mr. Gibbs calls a "nominal consideration."

Wm. Bracken,
President Consol. Elec. Storage Co.

New York, March 9, 1894.

THE STORAGE BATTERY CHALLENGE.

To all those sincerely interested in the advancement of electrical arts, there is something deplorable in the exhibition to which we are invited by the challenge of the Electric Storage Battery Company now being advertised, but it is not likely that any respectable business competitor of this company will enter a match for five hundred dollars a side. It is well known that public opinion is the only jury before which great issues can be determined, and it is just as impossible for Messrs. Houston and Kennelly to award these stakes to the best storage battery, as for one expert to pick out the greatest artist or the greatest poet of the ages.

Dr. Johnson himself did not venture to pronounce Shakespeare a great poet on his own authority, but required the test of time and public opinion, saying, "The sand heaped by one flood is scattered by another while the rock remains continually in its place. The stream of time which is continually washing away the dissoluble fabrics of other poets passes without injury by the adamant of Shakespeare."

The stream of Time can be counted on to wash away all the worst fabrics of storage battery development, and leave whatever is best, regardless of laboratory prize fights, even when men of scientific distinction hold the stakes.

Since, however, the proposed conditions will be widely read they are deserving of at least some criticism. The chloride claims to be 50 per cent. better than any other and yet this is qualified by the experts to mean $\frac{50}{300}$ instead of $\frac{50}{100}$. It would be very easy to construct a series of tests between two types of batteries so as to show an apparent superiority of 14 per cent. in favor of either. Now it is true although evidently not understood by the experts that if a competing battery had equal capacity per weight, equal efficiency and only ⅔ of the life of the chloride, that the latter would be 50% better, but who would claim that if efficiency and life were equal and the capacity per weight only $\frac{2}{3}$ that the chloride would be 50% better. A Planté battery equal in all other respects to the chloride might have a capacity per weight of $\frac{2}{3}$ and yet cost but half as much, and after it was worn out it might be worth 50 per cent. more; so that the cost to the owner would be less than half of the chloride for life and efficiency. Yet Mr. Gibbs would claim under the proposed conditions that his battery was 50% better. Does it not seem that these conditions were drawn up to insure the stakes of this prize ring to the chloride battery even if it were only half as good as its competitor? Among many questions that occur to me I might ask the following. What is meant by electrode? How much of the conductor, the supports or the active material does it include? Might it not also refer to the electrolyte? To what extent in terms of E. M. F. are the 100 preliminary discharges to be carried? Why is the discharge to be carried as low as 1.75 volts, and how does the E. M. F. fall on opening the circuit? What "is point of full charge"? Why is 1.75 volts fixed? Is it to exclude the Lalande-Chaperon type? Is it in order to ruin Planté batteries? What about zinc-lead batteries? "The durability is to be measured by determining the number of working hours of charging and discharging at the rate of 2½ amperes per pound of dry electrodes as shipped, which will reduce the storage capacity of the batteries in ampere hours to one-half of its first valuation at that point." What has this to do with annual cost? Do not negatives and positives have different lives and might not the ratio between their respective lives be affected by the treatment under which they are used?

ROBERT MCA. LLOYD.

NEW YORK, MARCH 10, 1894.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED FEBRUARY 27, 1894.

Accumulators:—

Secondary Battery, L. B. Rowley, Ashland, Wis., 515,502. Filed Feb. 7, 1893.

Consists of a combination of a series of tubes horizontally placed and supported at their ends and having spaces between them for the circulation of the electrolyte.

Alarms and Signals:—

Electric Railway Signal, H. V. Riley & Chas. Selden, Baltimore, Md., 515,366. Filed Oct. 5, 1893.

An automatic electric grade crossing signal for steam railways.

Auxiliary Fire Alarm Telegraph System, J. Sachs, New York, 515,508. Filed Feb. 15, 1893.

Signaling Apparatus, O. D. & M. A. Kleinsteuber, Milwaukee, Wis., 515,589. Filed Apl. 8, 1893.

A police signal consisting of a steam or compressed air whistle actuated by an electric circuit.

Electric Alarm System for Railway Crossings, A. J. Wilson, Port Chester, N. Y., 515,638. Filed Apl. 25, 1893.

Automatic Electric Railway Signal System, C. P. Breese, New York, 515,648. Filed March 22, 1893.

An electric block signal system for steam railways.

Signaling Apparatus, J. W. English, New York, 515,665. Filed Oct. 26, 1893.

An electric visual signal exhibiting at will letters, figures, etc.

Conductors, Conduits and Insulators:—

Insulating Thimble, I. A. Brown, Toledo, O., 515,321. Filed April 5, 1893.

Designed to cover the handle of the regulating device on an electric car.

Wire Coupling, D. A. Byers, Denver, Col., 515,420. Filed March 13, 1893,

Consists of an open ended tube enlarged interiorly and a detachable plate covering an opening leading to the central chamber.

Fixing Electric Conducting Wires to Insulators Supporting Same, R. Schomburg, Berlin, Germany, 515,448. Filed March 29, 1893.

Employs a binding piece adapted to hold the wire in position without the use of tie wire.

Distribution:—

Regulator for Continuous Current Arc Light Circuits, D. Higham, Boston, Mass., 515,473. Filed May 14, 1892.

An electromagnetic device responding to wave variations of current combined with a second device responding slowly to variations of mean intensity of current.

Dynamos and Motors:—

Dynamo Electric Machine, J. Wenstrom, Orebro, Sweden, 515,386. Filed Mch. 6, 1893.

Claim 1 follows:

In a dynamo electric machine the combination with the two poles of a field magnet, of an armature attached to one of said poles and having a continuous uninterrupted surface adjacent to the air gap, and a keeper of solid magnetic material revolving in the air gap between the said armature and the other pole.

Armature for Electric Machines, W. Fritsche, Berlin, Germany, 515,467. Filed July 1, 1893.

Comprises a core built up of a series of interspaced angular elements arranged radially on a hub and forming a cylinder of variable diameter and conductors interposed between the elements of that portion of the cylinder of greatest diameter in the planes substantially parallel with its axis.

Electric Motor, C. Doriot, Philadelphia, Pa., 515,488. Filed Mch. 11, 1893.

Claim 1 follows:

The combination with the motor frame having the base portion projecting at one side, of the belt guide pulleys mounted on said projecting portion.

Current Collector for Dynamos, O. R. Roberts, Addison, Pa., 515,613. Filed Aug 21, 1893

Consists of two endless belts of conducting material supported by adjustable sheaves.

Galvanic and Thermo-Electric Batteries:—

Primary Battery, C. J. Hubbell, Boston, Mass, 515,432. Filed May 31, 1893.

Employs a zinc element having a stud of metal projecting centrally from it and extending downward into a mercury cup which is connected with one of the binding posts.

Heating:—

Electric Heater, A. S. Hatch, Windsor, Can., 515,401. Filed Mch. 27, 1893.

Consists of a series of frames fastened to a face plate but insulated from one another and having a heat developing conductor wound spirally upon them.

Electric Heater, S. E. Nutting, Chicago, Ill., 515,693. Filed Apl. 27, 1893.

Claim 1 follows:—

An electric heater, composed of electric wires provided with terminals embedded in a non-conducting cement and between two layers of a flexible non-conducting material, in combination with an outer covering of textile fabric.

Lamps and Appurtenances:—

Electric Arc Lamp, G. Kirkegaard, Brooklyn, N. Y., 515,342. Filed June 19, 1893.

Claim 1 follows:—

In an arc lamp, a pivoted frame carrying a clockwork and escapement, the the escapement being located in one of two planes perpendicular to each other, one of which planes is vertical, the pivot of the frame being at the apex of the two planes.

Electrical Glow Lamp, H. Cottrell, Newark, N. J., 515,465. Filed Mch. 30, 1893.

A lamp illuminated by an electro magnetic discharge effected by applying a coating of tin foil or the like to the surface of an exhausted glass bulb and connecting the coating with a circuit adapted to induce an electro magnetic discharge across the interior of the bulb.

Socket for Incandescent Lamps, L. Stirn, New York, 515,484. Filed June 22, 1892.

A socket containing a ratchet switch actuated by pulling a cord.

Lamp Socket, L. Stirn, New York, 515.485. Filed Nov. 18, 1892.

Similar to No. 515,484.

Incandescent Lamp Socket, R. C. Nourse, South Framingham, Mass., 515,606. Filed May 31, 1893.

Metal Working:—

Apparatus for Electrically Heating or Working Metals, C. L. Coffin, Detroit, Mich., 515,652. Filed Feb. 9, 1893.

Claim 1 follows:

An electric arc metal working apparatus comprising electrodes for the passage of current and an arc disturber with mechanism for changing its relation to the electrodes during work.

Metallurgical:—

Method of Peroxiding Lead, W. W. Griscom, Haverford, Pa., 515,383. Filed July 17, 1893.

Employs an electrolyte of water, sulphuric acid and nitric acid in which the ratio of sulphuric to nitric is more than three to one.

Miscellaneous:—

Electric Gas Lighter, J. O. Dahlgren, Boston, Mass., 515,397. Filed Dec. 30, 1893.

Insulated Pipe Coupling, G. Peeples, Philadelphia, Pa., 515,716. Filed June 5, 1893.

Railways and Appliances:—

Bond for Electric Railways, J. Meyer, New York, 515,478. Filed Oct. 21, 1893.

Claim 1 follows:

The combination, with the rail ends, of metallic plates located below the rails and provided with downwardly extending lugs, and bonds connecting said lugs.

Conduit Electric Railway, J. A. Cassidy and W. A. Butler, New York, 515,572. Filed Aug. 24, 1892.

A sectional conduit railway whereby the passing car operates a toggle joint making contact with the line conductor.

Electric Railway. B. F. Comstock, Decatur, Ill., 515,654. Filed April 13, 1893.

A double track railway operated from a single trolley wire placed between and above the track and means for enabling two trolleys running in opposite directions to pass one another on the single wire.

Switches and Cut-Outs:—

Electrical Controller, E. A. Sperry, Cleveland, O., 515,374. Filed Aug. 23, 1893.

Claim 5 follows:

In an electrical controller, a switch, a handle for the manual operation of said switch, a main moving element for the controller provided with a separate handle, two sets of stationary and moving contacts, one controlled by each handle, those of one set being in series circuit relation with those of the other, a lock for the switch, and means connected with the main moving element for actuating such lock.

Telegraphs:—

Telegraphic Instructor, T. J. Houck and H. M. Browning, Baltimore, Md., 515,709. Filed Sept. 21, 1893.

Telephones and Apparatus:—

Switch and Circuits for Telephone Exchanges, J. J. O'Connell, Chicago, Ill., 515,531. Filed April 17, 1893.

Claim 1 follows:

The combination with a plug cord and with the contact terminals of an electric circuit of a circuit changer arranged to be shifted by said cord as the latter is moved.

A GOOD TEST OF IDEAL WIRE.

At the National Electric Light Convention, at Washington, D. C., were seen two coils of "Ideal" insulated wire, each 25 feet in length, No. 16 B. & S., soaking in water with the incandescent light circuit passing through them. These coils were, on invitation of Messrs. Queen & Co.'s representative taken to their laboratory in Philadelphia and tested to ascertain the "drop" between the two. The result of these tests has been furnished the Phillips Insulated Wire Company in a carefully made report by Mr. Willyoung including diagrams, etc., the gist of which is as follows:

With the top coil resting on the lower in water by its own weight, there was no loss or leakage that could be measured between the two coils. With the top coil weighted down by ten pounds pressure an escape of one tenth of one volt was found. The voltage used was 100 and we are informed the coils had been previously soaking in water over two months. This speaks well for a wire with no rubber or gutta percha in its insulation.

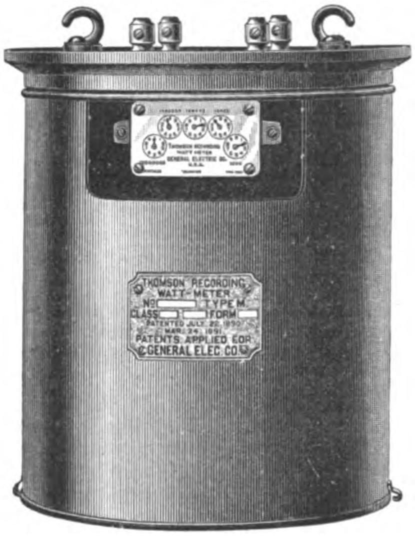
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THOMSON RECORDING WATTMETER FOR ARC CIRCUITS.

THE success which the Thomson wattmeter for incandescent circuits has experienced, has prompted the General Electric Company to design a recording wattmeter especially for the measurement of energy used in groups of arc lights in commercial lighting such as in stores, factories, halls and the like. This meter is the outcome of two and a half years of careful investigation and experiment. Indeed, probably no other meter or instrument manufactured by the General Company has received more careful study than this. It is a true wattmeter, modified in its principles only to meet the change of conditions of arc light service. It is similar in construction to the well known Thomson recording wattmeter, and has the same damping device—a copper disc and two permanent magnets.

It has been designed on the lines of an arc lamp so far as its location, etc., are concerned, that is to say, to be suspended from the ceiling by two brass rods fastened to a simple ceiling board, and the same object is attained as in the suspension of arc lamps from the ceiling—the meter is inaccessible except to those who understand its manipulation. A special feature of the meter is the safety cut-out contained within the cover proper. It is designed to close immediately on possible trouble occurring within the meter which might result in the burning out or breaking of the circuit. The cut-out serves to short circuit the meter and cut it out, rendering trouble in the meter impossible. At the same time it preserves the continuity of the circuit and permits the lights to burn without interruption, an advantage sufficiently obvious.



THOMSON RECORDING WATTMETER FOR ARC CIRCUITS.

The connections of the meter are exceedingly simple. The connection blocks are at the top, the wires being brought first to the ceiling board and then dropping to the meter. The two terminals farthest from the front of the meter are connected to the line through an absolute cut-out, the two front terminals being connected to the lamps in the house.

So far as the operation of the meter is concerned, it makes no difference which wire is positive and which negative, though, of course, to have the lamps burn correctly attention will have to be paid to this point. No trouble will be caused if the linemen should make a mistake and connect the wires which should go through the front terminals to the back, and vice versa; there will be no short circuit or burn out. The meter will run backwards but register correctly, subtracting instead of adding to the sum on the dial. The meter is shipped fully assembled and ready for installation. Careful tests show that the same high accuracy can be expected on a minimum load as on a maximum.

FORD AND BACON.

This firm, composed of Messrs. F. R. Ford and G. W. Bacon, both formerly with the La Roche Electric Works, has recently been formed, with offices in the Philadelphia Bank Building, 421 Chestnut street, Philadelphia, Pa. Electrical supplies will be handled and manufacturers who are not now represented in that city are invited to communicate with the company. The experience of both partners, together with their wide acquaintance, places them in an advantageous position to secure and retain a good business.

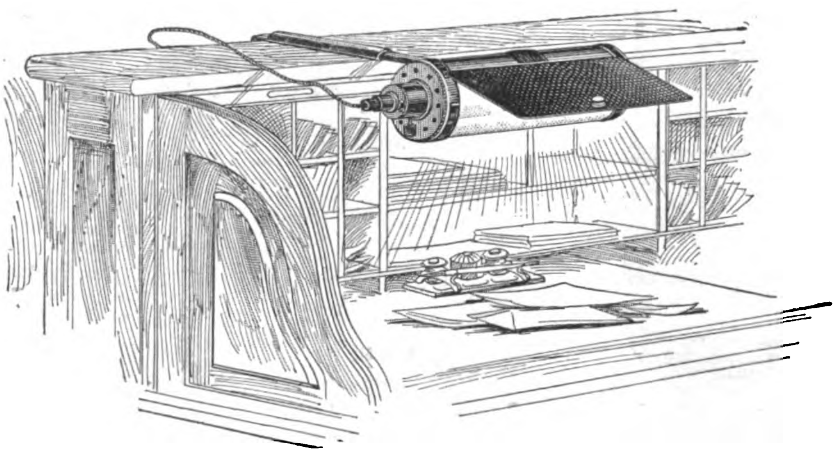
THE HORNBERGER ELECTRIC MFG. CO.

Elkhart transformers up to date form the theme, and in fact the entire subject matter, of a tasteful catalogue issued by the Hornberger Electric Mfg. Co., of Elkhart, Ind. The construction, installation and merits of the tooth type converter is treated of in a manner at once concise, clear and convincing, and several pages are filled with excellent testimonials from a number of well known companies and individuals throughout the country.

THE KINSMAN DESK LIGHT.

THE accompanying illustration shows the Kinsman desk light introduced by McLeod, Ward & Co., of 91 Liberty street, New York. It is entirely novel, and has many advantages. It is clamped on the desk as shown, without marring or interfering with the desk in any way, and has an adjustable arm which enables the cylinder to be pushed back or drawn forward as desired. The inner glass cylinder is so arranged that the light can be modified in intensity by a slight touch and the whole apparatus can be operated without rising from the chair.

These lamps are just as well adapted to music stands or upright pianos, to the illumination of paintings, etc., and can also be arranged to suit special desks or tables. It also contains an adjustable student's shade, which, while it shields the eyes, also acts as a reflector to light the desk.



THE KINSMAN DESK LIGHT.

ST. LOUIS NOTES.

MR. A. W. DUTTON, long and favorably known in connection with the Brush interests and later with the Short Electric Railway Co., has been appointed Southern agent for Texas and Louisiana for Leonard & Ellis. Mr. Dutton will make his headquarters at Houston, Tex.

THE ACME FILTER CO. are not complaining of lack of orders for their oil economizers, and speak in high terms of THE ELECTRICAL ENGINEER as an advertising medium, saying that a small card placed in our columns some time ago brought them replies from all over the United States.

THE ROSE ELECTRIC SUPPLY COMPANY are putting in an electric plant of twenty arc and 200 incandescent lamps at the rolling mills of the St. Louis Stamping Company on Second and Destrehan streets, in the north end of the city; they are also furnishing a 500 light alternating plant for Angola, Ind.

ALLEN & ALLEN is the style of a new firm in the electrical contracting business, with offices in the Roe Building. Both were until recently members of the St. Louis Electrical Engineering Co., have a wide acquaintance, and with their long experience in the business should have no trouble in securing all the work they can handle.

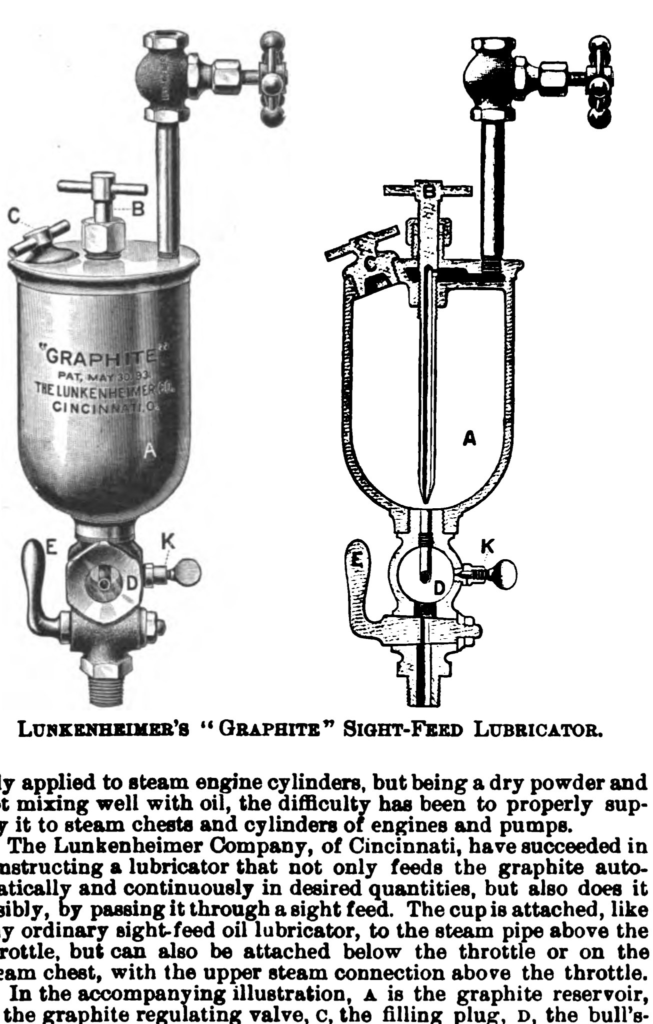
MR. LOUIS NAHM, secretary and general manager of the American Electric Mfg. Co. reports a good demand for their high grade "American" lamp, notwithstanding that a slightly higher price is charged for it on account of the superior material in its construction. This lamp is guaranteed to last 1000 hours while their regular "Republic" lamp is, they claim, the standard 600 hour lamp.

Jas. I. Ayer & Son, electrical and mechanical engineers, although established but a short time, are already so busy that a good deal of "midnight current" is being consumed at their offices in the Security Building. Messrs. Ayer & Broughton are getting out plans for an improved form of boiler setting for the regular horizontal tubular boilers, in which are incorporated some ideas due to many years' practical experience in the operation of the largest lighting station in the country.

Columbia Incandescent Lamp Co. All departments of this company are in full operation and in the shipping room more than ordinary activity prevails. The company are constantly putting in new labor saving machinery of their own invention, which will not only expedite the manufacture of lamps, but also secure more uniform results than ever. The Columbia Co. have recently secured the services of Mr. J. E. Randall, who was for seven years connected with the Thomson-Houston Co. at Lynn, in their lamp department.

LUNKENHEIMER'S "GRAPHITE" SIGHT-FEED LUBRICATOR.

It is well known by engineers generally, that pure flake graphite is far superior to oil or any other lubricant, when properly applied to steam engine cylinders, but being a dry powder and not mixing well with oil, the difficulty has been to properly supply it to steam chests and cylinders of engines and pumps.



Lunkenheimer's "Graphite" Sight-Feed Lubricator.

The Lunkenheimer Company, of Cincinnati, have succeeded in constructing a lubricator that not only feeds the graphite automatically and continuously in desired quantities, but also does it visibly, by passing it through a sight feed. The cup is attached, like any ordinary sight-feed oil lubricator, to the steam pipe above the throttle, but can also be attached below the throttle or on the steam chest, with the upper steam connection above the throttle.

In the accompanying illustration, A is the graphite reservoir, B, the graphite regulating valve, C, the filling plug, D, the bull's-eye sight feed chamber, E, the feed regulating valve, and K, the drain valve. The operation will be readily understood without further description. The cups are made of the best materials, thoroughly tested and fully warranted.

NEW YORK NOTES.

The Okonite Company, Ltd. will as usual be represented at the Convention. Capt. Willard L. Candee and Mr. Geo. T. Manson, will be on hand.

Messrs, Warren & Burhorn, of 136 Liberty street, New York, have been appointed consulting engineers to draw up plans and specifications for a complete isolated electric light plant, to be installed in the State Insane Asylum at Trenton, N. J. The plant will include engine, possibly direct connected, and wiring complete for about 1,000 lights. The Trenton Asylum with others, is under the control of the State Board of Managers of Asylums.

Mr. Walter S. Dix, formerly connected with the Crocker-Wheeler Elec. Co. has accepted a position as special sales agent for the Holtzer-Cabot Electric Co. with offices at 143 Liberty st.

The Perkins Electric Switch Mfg. Co., Hartford, Conn., have leased the entire property and plant of Waterhouse, Gamble & Co., and will continue the manufacture of that concern's well-known arc lamp. They are ready to receive orders for any quantity of arc lamps for incandescent circuits.

The Abendroth & Root Manufacturing Company, 28 Cliff st., New York city report a brisk demand for their Root improved water tube steam boiler, with recent orders of 248 h. p. for the Para Electric Light Company, Brazil; 2,000 h. p. for the tunnel plant of the Baltimore & Ohio Railroad, at Baltimore, Md.; 4,000 h. p. for Cincinnati Street Railway Company, and two large boilers for the Flatbush Gas Company, Flatbush, Long Island.

Mr. W. J. **Morrison**, agent for the Fort Wayne Electric Co., with headquarters at Syracuse, has sold a 750 light Wood alternating plant to C. F. Prentice, Le Roy, N. Y., where that gentleman has just completed a 400 H. P. water power installation, intended for central station light and power work. The Batavia, N. Y., board of alderman has also voted for an addition to the plant of 120 Fort Wayne lamps with dynamo, poles, wire, etc. Wood apparatus will be used.

Ideas Protected. Mr. Edward P. Thompson's "caveat" system consists of an attestation and legal execution of the gist of an invention before the proper officer as soon as possible after it is conceived. The document is then deposited in his safe and a certificate is given to the inventor. Two advantages are gained. The inventor may take more leisure in deciding about applying for a patent and in perfecting the details, and yet be confident of proving legally, when he made the invention; and secondly, the cost is only a mere trifle as compared to that of a regular Patent Office caveat. It is not so difficult to make an invention as it is to be the first in point of time; hence the advisability of getting the earliest possible dates fixed for all inventions and gradually sifting out the most important as subjects for patents. Mr. Thompson's address is Temple Court, N. Y.

WESTERN NOTES.

Mr. Jno. M. Fordham, the representative of the Bridgeport Brass Co., New York, was in Chicago last week.

Metropolitan Elevated Railway, Chicago.—It seems to be definitely decided now to use electricity as the motive power on this line.

La Roche Electric Works, Mr. Wm. Hood, Chicago agent, report the sale of a 1,300 light alternator to the Hammond, Ind., Light and Power Co.

"O. K." **Weatherproof** line wire is rapidly gaining ground as a leading weatherproof wire, and the Electric Appliance Company state that each month shows a large increase in their sales of this leading specialty.

Metropolitan Electric Co., Chicago. Since taking the general sales agency of the P. & B. compounds a most gratifying increase in the sales has resulted, the company having secured some very large orders recently.

Mr. J **Holt Gates**, Monadnock Building, Chicago, is installing a 1000 light Waddell-Entz direct current dynamo in the Hartford Building. The machine is of their well known slow speed type, coupled directly to a 12 x 12 automatic Cooper engine. A steam pressure of 115 lbs. will be used.

The Electric Appliance Company, without making very much hurrah about it, have been quietly building up a very nice trade on the Acme tape, a specialty which they first placed on the market something over two years ago and which has stood the test of time and made many friends.

Geo. Cutter, Chicago, reports a growing demand for the Pass & Seymour china wiring and window tubes, of which he is carrying a large stock at Chicago. Being thoroughly waterproof, they comply with the most rigid inspection rules and insure high insulation at all times. The scrutiny of work around Chicago is becoming more and more severe.

Mr. E. F. Seixas, for a long time identified with the Edison interests and later with the *Street Railway Gazette*, has entered the offices of Mr. J. L. Barclay, at 1645-8 Monadnock Building, Chicago. Mr. Seixas will especially exploit the street railway apparatus manufactured by the Walker Mfg. Co., of Cleveland, O. This company's reputation for high grade engineering work in street railway and power transmission will no doubt greatly benefit Mr. Seixas' efforts in this field.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

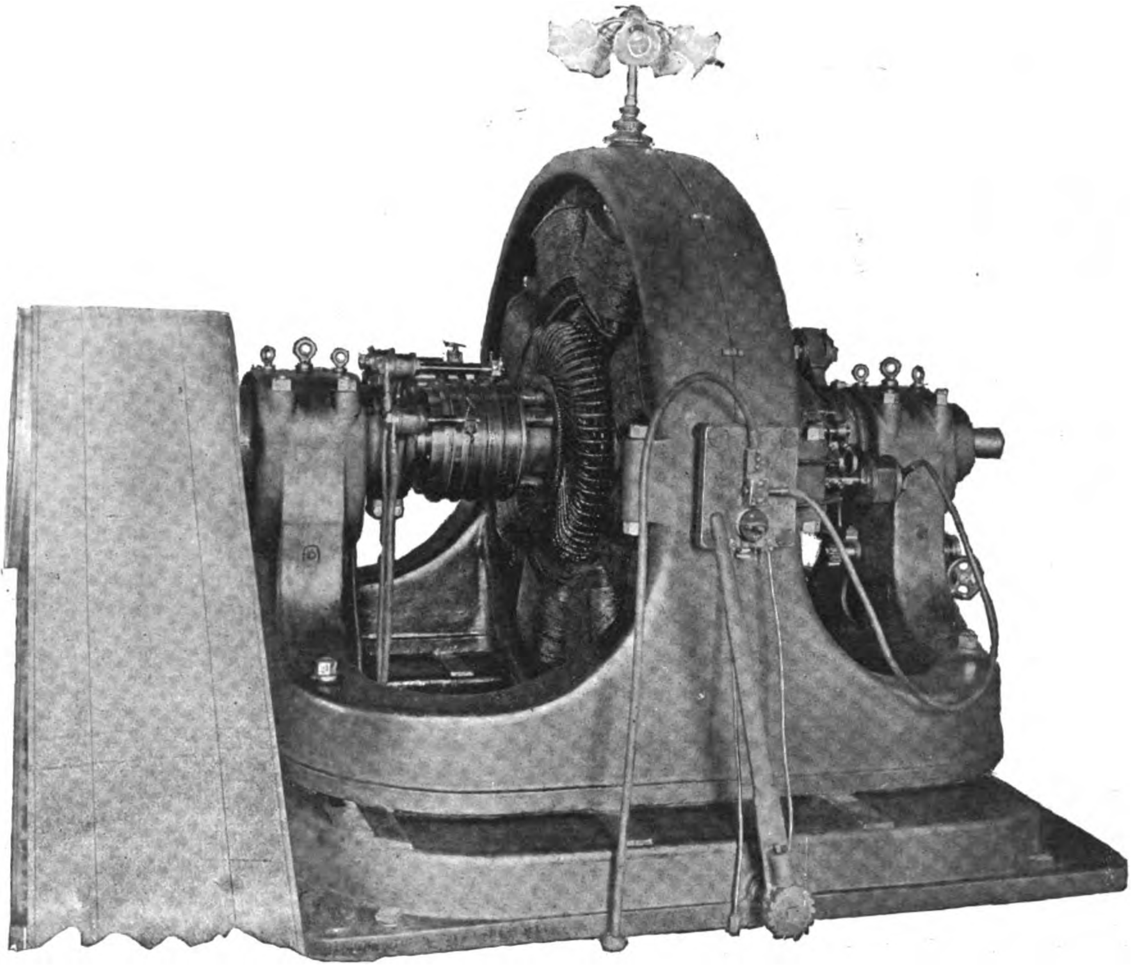
THE
Electrical Engineer.

Vol. XVII. MARCH 21, 1894. No. 307.

THE NEW WESTINGHOUSE COMBINED DIRECT AND ALTERNATING CURRENT GENERATOR AT ROCHESTER, N. Y.

BY

Jno. Dennis Jr.



The New Westinghouse Combined Direct and Alternating Current Generator.

THE Westinghouse Electric and Manufacturing Company has recently completed the installation of two generators of a new type, at the plant of the Citizens' Light and Power Company, at Rochester, N. Y., which apparently marks the beginning of a new departure in station operation. These two generators, which are exact duplicates, are the first of the type built, and the success in their operation is so marked that they seem to be worthy of more than passing notice.

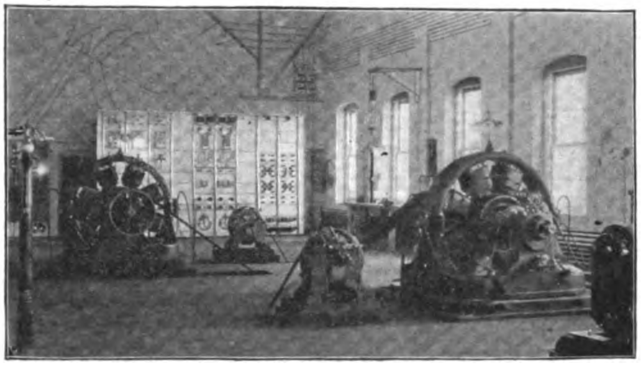
In the absence of a more specific trade name the machine may be called a combined direct current and alternating current generator. The peculiarity of this combination is that a direct current of 550 volts is taken from one end of the armature shaft and an alternating current of about 385 volts is taken from the opposite end of the shaft. In other words, the entire output of the generator may be utilized for direct current work, the entire output used for alternating current lighting and power purposes, or it may be divided between the two classes of work, in such proportions as may be desired.

The first impression produced by the new generator is its extreme simplicity of construction. The armature, which is essentially the same as the ordinary type of

Westinghouse single-wound iron-clad armature for street railway generators, revolves in an eight-pole field. It revolves at a speed of only 750 revolutions per minute, giving a frequency of 6,000 alternations per minute on the alternating side. The direct current end of the shaft is fitted with an ordinary commutator.

So far as the direct function of the generator is concerned, no explanation is necessary. The current is commutated in the usual manner, and does its work with indifference to the somewhat peculiar condition of affairs existing at the other end of the armature shaft. The alternating current side of the generator is arranged on the two-phase system; two alternating currents are delivered on two separate circuits, with a quarter-phase difference, thus enabling alternating motors to start with good torque.

The alternating current connection is made thus: The armature has a hollow core; the wires of the two-phase alternating circuits are given positive and negative connection to the commutator on the direct end of the shaft, the wires making suitable connections to collector rings on the alternate current end of the shaft. Thus, while the current is commutated and sent out from what I call the direct end of the shaft, the alternating currents are carried to the other end, and pass through the step-up transformers, on to the line, with the voltage increased to 2,000. The wires passing through the hollow core of the armature are bolted in the proper position to the back of the commutator.



Dynamo Room of The Citizens' Light and Power Company, Rochester, N. Y.

The fact that there is a voltage of only 385 at the alternating end and a voltage of 550 at the direct end seems to be a little perplexing. Possibly it is made a little clearer by the fact that in separate generators a direct E. M. F. is rated at its maximum, and an alternating E. M. F. is rated at the average of the curve, say seven-tenths; and obviously, the same rating must obtain when the different currents are combined in the novel way described above. The two-phase, four-wire systems are utilized in this combined generator and it is sufficient for the present to record the fact that all difficulty of equalizing the voltage on the circuit is obviated; in other words, it has been demonstrated that absolutely no balancing is necessary, a fact which will be duly appreciated.

It should be noted that, while the combined generator does all kinds of work except series arc lighting, the alternating feature gives all the advantage of transmission of current, besides bringing into use the important feature of self-starting alternating motors. It will be seen at a glance that, under these conditions, the generator is capable of work on the following lines: Direct current motor work; incandescent lighting by alternating current; alternating current motor work; alternating current arc lighting; street railway work. It is of course unnecessary to occupy space in pointing out the advantages to a medium-sized station, running night and day, on the various classes of work which have been enumerated, and the distribution of load from one end of the shaft to the other, at will, without shutting down.

Another element must not be lost sight of, and that is the safety of operators at the station, secured by the low voltage. The alternating current goes to the transformer with a voltage of only 385; a fact which tells its own story.

A description of these two combined generators, which are making such a sensation in electrical circles in Rochester, would not be complete without some reference to the model electric light and power station where they are installed and in successful practical operation. The station of the Citizens' Light & Power Company is situated below the Lower Falls, on the west bank of the Genesee River. The building is three stories high, having an entrance in the rear from the flats, and from Mill street by stairway from the front. The first or ground floor is sixty by fifty feet. It contains two 500 horse power turbines, with room for two more. It also contains one 500 horse power engine, with places for three more, thus duplicating the water power plant with steam power. Adjoining is the boiler room, ninety-one by forty-eight feet with a capacity of 2,000 horse power in boilers. Directly over the engine room is the shaft room, which is eighty-four by fifty feet, with four lines of shafting, so arranged that either line of shafting can be run from either water wheel or either engine. The water wheels are connected with the shafting by a rope drive. Above the shaft room is the dynamo room, ninety-four by fifty feet.

The building is thoroughly fire-proof, as the only wood used in the construction is in the floors. All the girders are of steel, with steel truss roof, and the walls are laid in Portland cement. The water is conducted from the race on Mill street to the turbines through a steel flume, seven feet in diameter, with a head of ninty-three feet. The building and shafting were constructed under the direction of Robert Cartwright, of Rochester.

The wires are brought into the building through a brick tower entirely separate from the building. Then the wires come to the switchboard through a two foot wall, with porcelain tubes. This was constructed when the building was erected.

In the dynamo room, besides the important combined generators described, are two sixty lighters, of the latest type made by the Western Electric Company, for arc lighting, and others are to be installed. The plant includes the latest improved Westinghouse combination panel switchboard, which is said to be superior to the one exhibited by that company at the Columbian Exposition, and to be the finest example of switchboard in the United States. The skeleton frame is of iron, the instruments being mounted on handsome marble. The instruments, which were designed and manufactured by the Westinghouse company, are of the latest type and most approved design. The switchboard is so designed that additional dynamo or feeder panels can be added without disturbing the parts already in position, or interfering with the operation of the plant.

The foresight and good judgment of the efficient superintendent of the Citizens' company, Mr. John A. Almstead, will be appreciated when the fact is made known that he visited Pittsburgh in company with General Manager E. M. Higgins, before a single pattern of the combined generators had been made, and virtually took the responsibility of the selection of the present system. That his judgment was a good one, is shown by the gratifying results, now that the plant has been fully installed and is in successful and singularly economical operation. The stockholders of the company are all prominent business men of Rochester. The officers of the company are: President, Robert M. Myers; vice-president, H. Wheeler Davis; secretary, H. Willis; treasurer, P. V. Crittenden; general manager, E. M. Higgins; superintendent, J. A. Almstead.

THE ELECTRIC RAILWAY AND ILLUMINATING PLANT OF THE MILWAUKEE STREET RAILWAY COMPANY.—II.

BY

Otto Frick

RAILWAY ENGINE ROOM.

THE railway engine room, Fig. 6, which is 95 feet long, 45 feet wide and 30 feet high, contains five sets of Edison triple expansion vertical engines, of 600 h. p., with two 200 kilowatt Edison multipolar dynamos keyed one to each end of the shaft. Two of the engines were built by the Filer & Stowell Company, of Milwaukee, Wis., and the other three by The J. Morton Poole Company, of Wilmington, Del., and all were designed by the Edison General Electric Company. The cylinder dimensions are 16¼ x 23⅞ x 38½ by 30-inch stroke with 600 feet piston speed per minute, corresponding to 120 revolutions. All cylinders are steam-jacketed. All engines are designed to run at the normal speed of 120 revolutions, no matter how the load varies, this being accomplished by independent, automatic, centrifugal governors, fitted to each cylinder as in other high speed engines of the fly-wheel governor class. In this instance, however, they are contained in a disc bolted to the shaft. The three independent governors have proved their advantages in being able to keep the efficiency of the whole generating unit higher when operating light loads than when the governor was confined to the high pressure cylinder alone with the intermediate and low cylinders fixed, to say nothing of the advantage in having three independent governors guarding against any accident due to breakdowns. This is of great value, especially in railway plants.

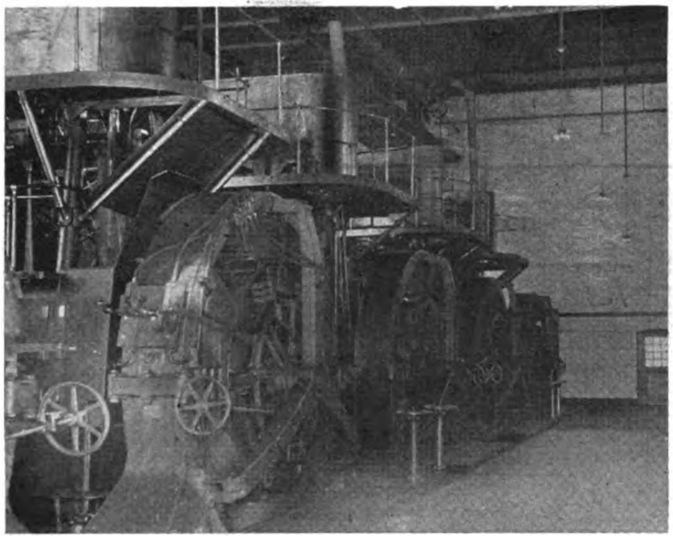


FIG. 6.—THE RAILWAY ENGINE ROOM.

The dynamos are of the well known multipolar Edison type with 6 magnet poles, ring wound armatures and commutators formed by the side of the armature winding. The six brushes are mounted upon a spider, which can be moved by a tangential screw into the proper position and all brushes may be simultaneously lifted from, or lowered upon the commutator. All the generators run very smoothly with no appreciable sparking at the brushes. They are compound wound and the standard of 500 volts is well maintained as the very slight variations of the voltmeter show. Measurements taken show the efficiency of these units to be 86 per cent. and the percentage is well kept up both on over-loads and extremely light loads.

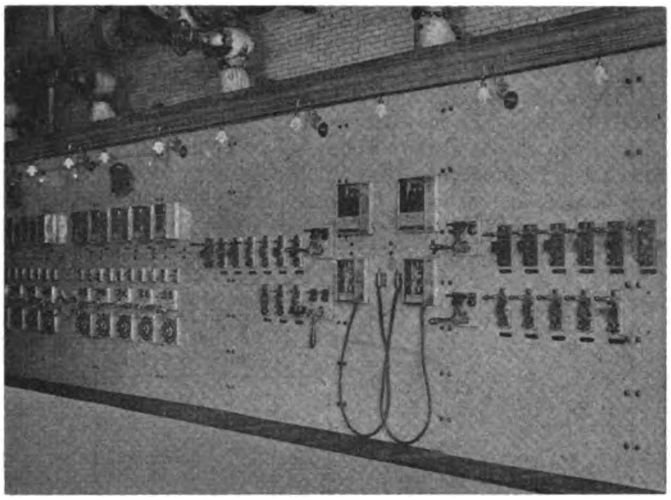


FIG. 8.—THE SWITCHBOARD.

Switch-board.—The switch-board, of white marble, measuring 72 feet in length by 10 feet in height, is placed along the south wall with convenient space left at the back for the cables and connections. It is divided into two distinct halves; the dynamo board and the feeder board. A switching diagram is shown in Fig. 7 and a view of the switch-board in Fig. 8. All the negative cables, passing through the large double pole switches on the dynamos, are connected to a common bar on the back of the board, communicating with a second bar in the basement from which the return-feeders start. All the intermediate cables from the positive brushes are similarly connected but without any switches; the positive cable from the end of the compound winding being joined to the common bar, passes a switch, ampere meter and a fuse on the switch-board. Beneath each set of this apparatus is the handle of the shunt regulator. Two differential galvanometers with sliding switches for parallel coupling and two large Weston station voltmeters complete the outfit.

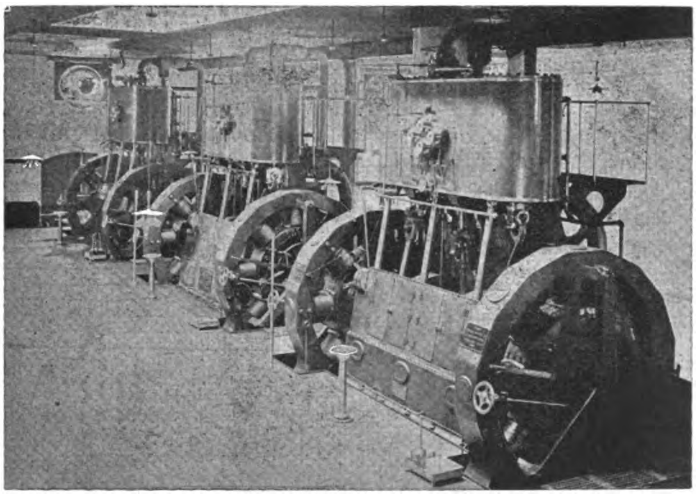


FIG. 9.—THE LIGHTING ENGINE ROOM.

From the positive bar the current passes through two amperemeters to four bars, which in case of emergency, can be interrupted by four heavy switches without causing too sudden a break of the full load. The feeders are led from the four bars, passing through a copper-wire fuse and a simple switch. To measure the current taken by each feeder, two amperemeters are provided, which can be switched on any of the feeder circuits by means of flexible cables and plugs. The fuses are made of copper wire, spirally wound to produce a strong magnetic field when a short circuit occurs. The arc formed by the fusing of the wire is blown out by the magnetism, and the destroying effects of the arc are thus prevented. The able electrician of the plant is the inventor of the simple device.

Electric Light Department.—The electric light department, Fig. 9, occupies nearly the whole upper floor with a free floor space of 95 by 84 feet. It is 20 feet high over the beams, but only 16 feet over the floor plates, 4 feet being reserved for piping and cable connections underneath. At present three engines of 300, and one of 150 h. p. are installed, and 12 additional 300 h. p. engines will complete the plant. The units are of the same type as the railway plant, the only difference being that the dynamos are shunt wound, operating at present at from 115 to 120 volts. Each unit is working directly on the three wire system.

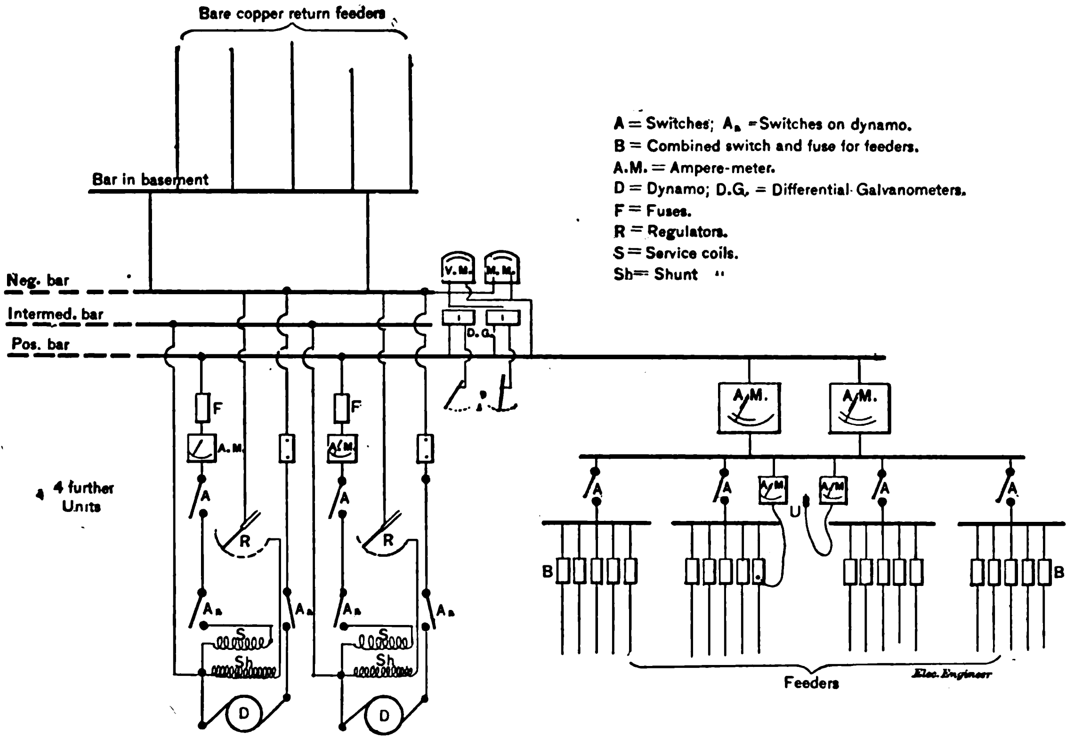


FIG. 7.—SWITCHBOARD CONNECTIONS FOR RAILWAY PLANT.

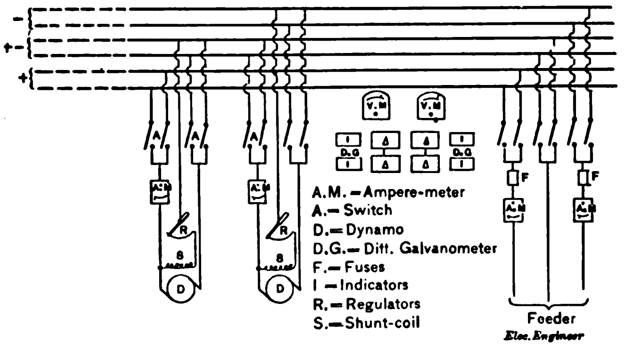


FIG. 10.—CONNECTIONS ON SWITCHBOARD.

The switchboards are placed around the east stack, and raised about five feet above the floor to give the attendant a good view of the whole room. The underground cables connect the dynamos with the board, where the current passes through an ampere meter and one double switch for each pole, Fig. 10. By means of these double switches and corresponding double bars it is possible to run dynamos at different voltages to suit the different losses in the feeders at heavy load. From the diagram Fig. 11, it will be understood how, with three dynamos, four different pressures can be obtained. This is necessary when operating outlying districts, although it may seldom be required.

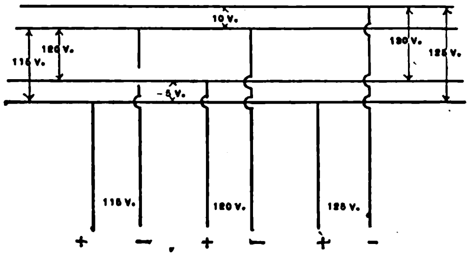


FIG. 11.

Efficiency of Plant.—Reliable measurements, giving exact figures as to the efficiency of the different parts of the plant, have not yet been made, but the results elsewhere obtained with the adopted types, give us an idea of what may be expected. To dwell on the boilers may not be necessary, as general experience has shown the Galloway boilers to be in every respect equal to the most efficient boilers in the market, and the arrangement and thorough protection of the steam piping excludes the possibility of any appreciable amount of loss by condensation.

Tests made in Milwaukee show an unusually high efficiency of engines and dynamos, and a very complete set of tests made in Boston on the same type of engine as used for the railway plant, confirms the results. Fig. 12 shows the I. H. P., commercial efficiency, and the steam consumption curves obtained in Boston as an average of a large number of readings. The efficiency of the unit was very high, giving in some cases, over 87 per cent., and on an average, at half load, 80.8 per cent. At three quarter load it gave 84 per cent. and so on, the steam consumption being very nearly that for which they were designed, *i. e.*, 15 pounds per I. H. P., showing on an average 18 pounds, between half load and full load. These figures indicate sufficiently the high degree of perfection of the generating units. It may be mentioned here that in the design it was intended to get the maximum efficiency curves of steam engine and electric generator to cross at the same point, that point being the longest duration of load. That decided upon was 80 per cent. of its normal capacity, and, considering that neither the engine nor the generator had at that time been constructed, the results are very good indeed.

Distributing System of Electric Light Plant.—The distribution of current is made on the three wire system, and all conductors are laid underground in Edison tubes. The diagram, Fig. 13, shows the extension of the mains and the points where the feeders are connected to them. Starting from the station are ten feeders, some of which are bifurcated, branching off to different points, and thus securing good equalization of pressure. The outer cross section of feeders and mains is given with the diagram. The section of the neutral wire is one third that of either of the outer ones in the case of feeders; in the mains all three wires have the same section. From each of the feeding points, seven wires, placed in the same tubes as the feeders, run back to the station, partly for purposes of testing and control, but mainly to regulate the pressure in the net-work.

The extension of the conductors from the station is remarkable, forming a net-work over one and one-quarter mile from the station. Up to the present time about 13,000 incandescent lamps of 16 c. p., 74 arcs, and 350 h. p. in motors, varying from ½ to 15 h. p. have been installed.

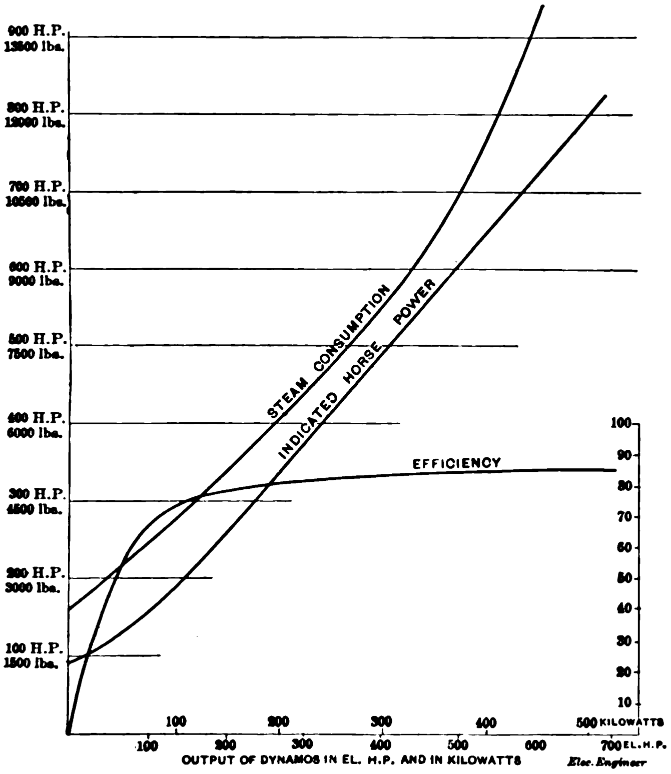
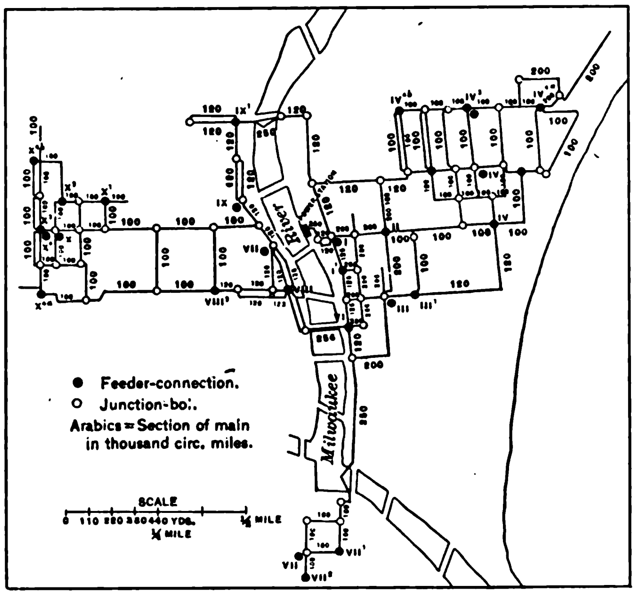


FIG. 12.

The comparatively small number of incandescent lamps in use as yet is doubtless due to the high price of one cent, as compared with gas, which is sold at half that price.

Motors and Meters.—Commercial power is also sold from the lighting conductors, and is used to a very large extent for operating elevators and other machinery, and in some cases draw bridges over the river. The amount of power at present supplied is about 400 h. p. Edison meters are used and give full satisfaction as to exactness, but the trouble involved in the weighing of the zincs seems to be a drawback. A very neat, well furnished meter-room with all necessary chemicals, balances and other instruments is placed near the office of the Edison Electric Illuminating Company.



SECTION OF FEEDERS.

I. = 250,000 cir. mils.
I.^{1} = 200,000 cir. mils.
II. = 250,000 "
III. = 650,000 "
III^1 = 100,000 "
IV. = 650,000 "
IV.^{1} = 200,000 "
IV.^{2} = 100,000 "
IV.^{3} = 100,000 "
IV.^{4} = 450,000 "
IV.^{4a} = 350,000 cir. mils.
IV.^{4b} = 150,000 " "
IV.^{5} = 150,000 "
V. = 100,000 "
VI. = 550,000 "
VII. = 350,000 "
VII.^{1} = 2 x 150,000 single
VII.^{2} = 2 x 150,000 "
VIII. = 450,000 "
VIII.^{1} = 300,000 "
VIII.^{2} = 150,000 "
IX. = 300,000 "
IX.^{1} = 300,000 "
X. = 350,000 "
X.^{1} = 100,000 "
X.^{2} = 100,000 "
X.^{3} = 100,000 "
X.^{4} = 100,000 "
X.^{4a} = 100,000 cir. mils.
X.^{4b} = 100,000 " "

FIG. 13.—ELECTRIC LIGHT MAINS AND FEEDERS.

A POOR QUARTER FOR WESTERN UNION.

The directors of the Western Union Telegraph Company met last week, and declared a quarterly dividend of 1¼ per cent.

The quarterly report presented is not very pleasing, showing, as it does, a deficit after paying the regular quarterly dividend of $378,737, as against a surplus last year of $229,288. The total surplus now amounts to $6,893,318. The earnings, $806,263, on the stock outstanding, $94,820,000, for the quarter were .85 of 1 per cent.

THE ANTWERP EXPOSITION.

THE Commissioners of the United States to the Antwerp International Exposition call the attention of manufacturers and producers to the fact that the exposition will open May 5. Applications for space and concessions should be made before April 1 at 14 Church street, this city. Low rates for shipments to the exposition have been obtained.

MR. GEORGE P. LOW, the electrical expert in insurance matters, has resigned his position as a member of the electrical engineering staff of the Midwinter Fair, and has been extremely busy catching up with arrears of his own immediate professional work.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies, - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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DISTRIBUTING NIAGARA'S POWER THROUGHOUT NEW YORK STATE.

WHEN the project for utilizing the power of Niagara Falls for commercial purposes and distributing it electrically was broached, probably few, even among the most sanguine, in electrical circles, were hopeful enough to believe that the limits of distance to which the power would be transmitted would greatly exceed those which had already been shown to be practical; and indeed it seems to have been the general impression that the object of the Niagara promotors was to concentrate manufacturing interests at or near the Falls, electricity being adopted as the most feasible and economical method of supplying the necessary power. It has required but a short time, however, to bring out forcibly the fact that those interested in the Niagara project have looked farther ahead, and that their ideas of the limits of transmission are by no means confined to those of present practice, but, on the contrary, appear to range little short of the unlimited.

The first indication of the purpose of the company was shown in the experiments in electric canal boat propulsion undertaken late last fall near Rochester, and which were fully described in THE ELECTRICAL ENGINEER. These experiments, it will be remembered, were carried out with money appropriated by the State of New York for that purpose under the authority of Chap. 499 of the Laws of 1893. Section 1 of this Act authorizes the Superintendent of Public Works to designate some portion of the Erie Canal upon which these experiments could be made and to formulate rules for their conduct. Section 2 of this Act, however, reads as follows:

> **The Superintendent of Public Works, may from time to time authorize any person to construct, maintain and operate electric conductors for light, heat or power, upon or along any canals of the State or any portion thereof, upon such terms or conditions not inconsistent with the public use of such canals as he may impose; and in like manner he may contract for or permit the use of such light, heat or power upon any such canal; provided that he shall thereby create no charge against the State, except as against appropriations lawfully applicable to such purpose.**

Acting under the authority conferred by this clause Superintendent of Public Works, Mr. Hannan, has just concluded a contract with the Cataract General Electric Co., conferring upon it the right to enter upon all canal lands of the State for the purpose of constructing either on or over or under either canal bank a system for propelling canal boats by electricity, without interfering with the present method of operation. Central power houses may be erected for this purpose. The rates for towage are subject to modification and review by the State Superintendent of Public Works, but such rate shall not exceed $20 per electrical horse power for any season of navigation.

An important provision is that the company may, so long as the wants of the canal are supplied, employ its electric plant along the line of the canal in furnishing electric light, heat, and power for distribution to any point or points beyond the line of the canal, and thus may furnish electricity for lighting and power purposes in all of the cities and villages along the canal. The company is to furnish the State, free of charge, sufficient power to operate motors to open all gateways leading to and from locks, and also electric lights sufficient to properly illuminate such locks at night.

The company must have its plant for operating boats by electricity in operation on the Erie Canal between Buffalo and Albany within three years from date, or else the privilege accorded by the permit will be forfeited. In case the company shall construct along the canals an electrical plant for use such as the trolley system, it shall be the privilege of the State to condemn and purchase such property at a price equal to the actual original cost, with 10 per cent. added thereto.

The far reaching nature and the possible effects of the rights thus granted have naturally aroused animated discussion, and much adverse comment has been heard on the action of Superintendent Hannan. Indeed on the very day that the contract was signed a bill to repeal Chapter 499, above quoted, was before the New York Assembly, which has since been passed in that body and has already been favorably reported to the Senate, so that there is little doubt of its passage in that body also. In the mean time the promotors of the enterprise with the contract in their possession propose to get to work in order to show their good faith in the matter.

It must be evident that the part which electric canal boat propulsion will ultimately play in this undertaking sinks into comparative insignificance as compared with the broad field opened for furnishing power to the cities adjacent to the canal. These embrace the largest and most important towns in the State of New York, and we need only mention such cities as Buffalo, Rochester, Syracuse, Schenectady and Albany to indicate the scope of the field. Nearly all, if not all, the cities through which the canal runs have electric central stations and speculation is already rife as to the probable effect of the appearance of so powerful a rival in the field. Nothing definite is yet known as to the plans of the Cataract Company, but an outcry has already been raised that the local electric companies will be at its mercy if those companies do not accede to its demands. It is evident that if the Cataract Company can furnish power at any considerably less cost than it can be generated locally, two methods are open to it: It can either contract to furnish the local company with power to drive its machinery or transform, as it pleases, and not in anyway interfere with the business of local distribution; or, it can go into the business of local distribution itself as a direct competitor. We would consider the adoption of the latter plan most unfortunate for reasons which are not difficult to discern. Its consummation would mean the practical ruin of companies which have been built up by years of toil and the expenditure of many hundreds of thousands of dollars and many of which have but recently begun to enjoy the benefits of their early enterprise. To deprive them of these benefits now would be working a hardship which no fair minded person would countenance. But if, on the other hand, the Cataract Company, or its sub-company, the Niagara Falls Power Co., have in view solely the furnishing of power to local companies at rates cheaper than those companies can produce it themselves, then the enterprise is deserving of all the encouragement which can be given to it.

All these speculations and fears are based, of course, on the supposition that electric power *can* be transmitted cheaper from Niagara Falls than generated locally along the line of the Erie Canal. Without desiring in any way to dampen the ardor of the promotors or friends of the transmission scheme—and none can wish it greater success than ourselves—we are forced to confess that with our existing knowledge and experience, the scheme, in order to prove successful, will require heroic treatment.

Of course, we have the Frankfort-Lauffen experiments to fall back on; but while they give some indication they can not be considered in any way conclusive, as the actual power transmitted was but a trifle compared with that contemplated in the present instance, and experience has but too well shown the difference in the disruptive strength of insulating materials and the action of circuits when the high potential has a heavy current back of it. We must also bear in mind that the companies situated along the Erie Canal are very favorably located for obtaining coal cheaply.

We shall hail with delight any method that will enable electric current to be distributed at a lower cost than it can be supplied to-day and hence await with no little interest the promulgation of the details by which it is hoped to accomplish this with Niagara as the original source.

ELECTRIC COOLING AND HEATING.

THE lengthening days and a March of unusual mildness remind us that Spring is at hand, with its demand for electric service of a kind that has not been needed during the winter months. Hitherto that service has taken the shape of cooling and ventilation, and the market for electric fans has become one of no small magnitude. Even now active preparations are being made for the spring trade, and it is safe to assume that the coming summer will see more electric fans at work than ever before. The old ones are furbished up from season to season, and even the inefficient types are kept in use, the customer having rarely got it through his head that, as with a low efficiency lamp, what he saves in cost of apparatus is wasted in undue consumption of current; while newer forms, with novel adjustments, continually make their appearance.

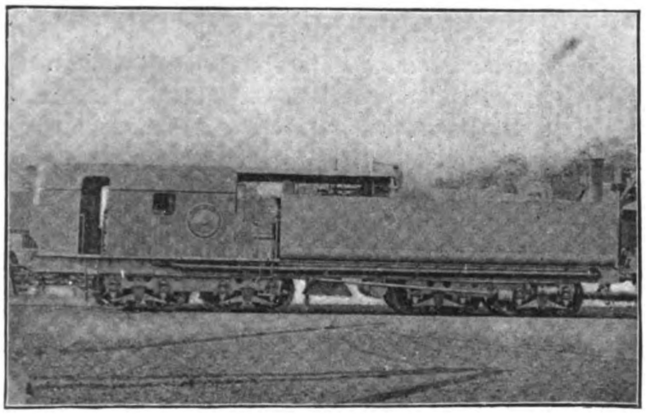
But the period in the development of electric arts has arrived when it is the duty of the central station manager to give his attention as much to electric heating and cooking as to electric cooling and ventilation. It is a fact that apparatus for cooking is now obtainable that people can use with economy and satisfaction. We could mention cities in which several residences have been fitted up with a plain ordinary kitchen outfit, and where the results are admirable. It is a mistake for a local company to view this new department of possible business with suspicion or prejudice any longer. In doing so, it makes once more the mistake that the gas companies made as to gas stoves, etc.; although at the present time gas companies have not only seen their error but have even gone so far as to sell gas stoves, etc., at bare cost, merely to induce the consumption of their product. This is the true lesson for central stations. What they need more than anything else is a day service and a flat load line, and to this end, electric cooking and heating apparatus may be applied with notable success. A local company that is making a canvass of its field this spring for fan and power work generally, may just as well include cooking, etc., in its survey. In most houses and apartments during the summer, the old cooking apparatus adds greatly to the discomfort caused by the weather; and wherever current is available electrical apparatus should find a hearty welcome. But the local companies must work with, and encourage by their orders, the manufacturers of such utensils and appliances. Let them keep sets on view at their offices; let them organize little exhibitions to show what can be done; let them reach out to the public through the local newspapers; let them employ every means of rendering such novelties familiar and popular. The results on the station output will be gratifying, and the summer earnings can be made in such ways just as heavy and profitable as those of the winter months.

ELECTRIC TRANSPORTATION DEPARTMENT.

TRIAL OF THE HEILMANN ELECTRIC LOCOMOTIVE.

In our issue of May 17, 1893, we gave a description of the electric locomotive design by Mr. J. J. Heilmann, of Paris, in which a most novel method of operation was carried out. This locomotive it will be remembered, derived its power from motors mounted directly on the axles and driven by current generated on the locomotive itself which contained a boiler and compound horizontal engine directly connected to a six-pole 800 h. p. generator. During the last few weeks this locomotive has been subjected to a series of official trials by the engineers of the Western Railway Co., of France, on a section of line between Havre and Beuzeville. Besides taking complete readings with the dynamometer car, apparatus was distributed along the line to measure and record automatically the deflection of the rail during the passage of the engine. A correspondent who was present during the trials furnishes us with the following interesting particulars of the results obtained.

The Western Railway Co. furnished a train of the same composition as their Paris express trains, but limited the speed strictly to 100 k. m. (62½ miles) per hour. However, when the Western Railway people convinced themselves that the engine ran with phenomenal smoothness at 95 k. m., on a very bad piece of track, (one could write with perfect ease at this speed when standing on the foot plate) and that the rail deflection indicators showed that the deflections were much less than with their regular express engines, they allowed the speed to be raised to 118 k. m. (74 miles) per hour, always with the same result. The general impression of the railway people present seemed to be that the scheme was a success, and that it would lead to the construction of much more powerful engines so that heavier trains could be hauled at higher speeds and with greater safety than with the present types. In fact, designs are now being prepared for a locomotive capable of developing 1200 h. p. normally, and with a maximum capacity of 1500 h. p.



THE HEILMANN ELECTRIC LOCOMOTIVE.

The great bugbear with this system so far has been the supposed losses by transformation of power into electricity and the transformation back again. But tests were also made of the consumption of coal with the electric locomotive and this compared with the coal consumption on express engines on the same line doing the same work. The results showed about 20 per cent. in favor of the Heilmann locomotive. The loss of power by the various transformations is thus shown to be less than the friction occasioned by the transmission by cranks and connecting rods.

The friction of the electric locomotive was even less than anticipated. Thus the Heilmann locomotive would not stand on a grade of 3.4 per cent. without applying the brakes. On a down grade of .8 per cent. the locomotive obtained a speed of 95 k. m. without any help from the engine, steam being entirely cut off. One of the express engines of the Western Railway will not go down this grade without the aid of steam, the resistance of engine and tender being more than 10 k. g. per ton, whereas the resistance of the electric locomotive is less than 3.4 k. g. per ton.

Of course in such a complicated machine, it was expected that some defects would crop up, chiefly in details, mostly the consequence of bad work, things which will be easily remedied and which do not concern the general features of the machine.

THE WINNIPEG, Canada, electric street railway is now carrying passengers at the rate of two cents.

THE WHITE-CROSBY CO.

THE firm of J. G. White & Co. of this city, which has done so much of the heavier electric railway work in American cities, is to enjoy a most important accession to its ranks on May 1, when it will be joined by Mr. Oscar T. Crosby, so long the mainspring of the Railway Department of the General Electric Co. The organization of the new company, to be known as the White-Crosby Co., is rather for convenience than anything else, as these two engineers will practically operate as partners. The fact of Mr. Crosby's resignation has been known to his personal friends and intimates for some months, but he has found it by no means easy to relinquish work to which he has devoted such close and unremitting attention; and hence he has preferred that nothing should be said on the subject till he could actually "clean up his desk." The change is made with the utmost harmony and cordiality still existing between him and his old coworkers in the General Electric Co. Those who know Mr. Crosby are not surprised, however, that he should prefer to work independently rather than for a large corporation, and that for professional motives he should free himself from the entanglement of so much laborious work of a commercial nature. It is to be hoped that a fitting occasion will shortly present itself for signalizing this important step on the part of one who has endeavored so successfully to promote the electric railway art, and who from first to last has stood for sound engineering, scientific methods and a progressive, impartial spirit of inquiry as to what is fittest and best in dealing with each new problem as it arises.

THE HESTONVILLE, MANTUA & FAIRMOUNT TROLLEY ROAD, PHILADELPHIA.

WE learn from Mr. A. Langstaff Johnston, C.E., E.E., the chief engineer of the road, that the contracts are about to be given out for a large part of the work on the Hestonville, Mantua and Fairmount line. The power station will be erected at Twenty-sixth and Callowhill streets, Philadelphia, Pa., on the Schuylkill river, occupying part of the property used by the Race and Vine streets line for a depot and stable. It will have the advantage of easy delivery of coal from boats. The station will be of stone and Pompeiian brick, one story in height, and of attractive appearance.

It will have a capacity of 2,000 horse power, and, if more is needed in the future, the capacity can be doubled by extending the station on the company's property. The equipment will consist of four cross-compounded engines of 500 horse power each, belted to the same number of 400 kilowatt generators. Eight boilers, each of 250 horse power, will make the steam, and there will also be the usual auxiliary machinery, switchboard and safety devices.

ELECTRICAL LAUNCHES IN VENICE.

IN the account of the placing on the Canals of Venice, of one of the electric launches employed on the lagoons at the World's Fair we omitted to mention that the launch was taken over from this country and put in complete operation by Mr. H. S. Lathrop, who was attached to the launch service at Chicago. Mr. Lathrop has just returned from Italy and speaks quite hopefully of the prospects of electric navigation in Venice.

TO ELECTRIFY BROOKLYN BRIDGE.

Proposals will be received by C. C. Martin, Chief Engineer and Superintendent of the New York and Brooklyn Bridge, at his office, 179 Washington street, Brooklyn, N. Y., until April 5th, 1894, for plans, specifications and estimates for lighting the Bridge Cars by Electricity; also for heating them, also for propelling them.

ELECTRIC LINE FOR NORTH CHICAGO.—The ordinance authorizing the North Chicago Electric Railway Co. to extend its lines in the north division of the city and connect with the cable lines of the North Chicago Railway Co. was called up in the city council on February 26. After considerable discussion about a proposition, permitting the charging of double fares north of Belmont Ave., the ordinance was passed by an almost unanimous vote. At the same meeting an ordinance for an electric street railway, to be operated by the storage battery system, from Franklin street along Southport avenue to the northern limits of the city, was introduced and referred to the Committee on Streets and Alleys north.

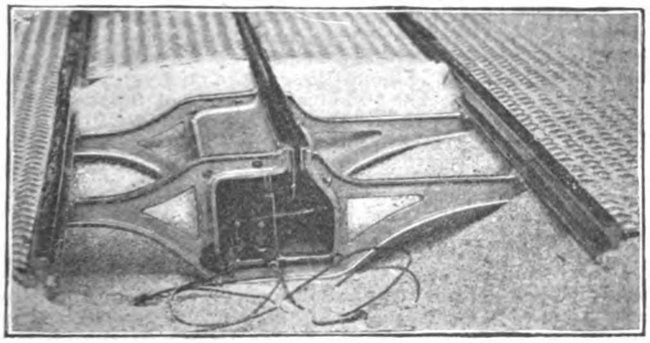
THE PETERSEN CONDUIT RAILWAY SYSTEM.

A WORKING model of an underground conduit system for the propulsion of street railway cars which is the invention of Mr. H. Petersen, proprietor of the Petersen Electrical Works, of Milwaukee, Wis., has been on private exhibition in New York city, and has attracted much attention, and elicited much favorable criticism.

In the construction of underground conduits for electric railway conductors or wires, suitable provision against the accumulation of moisture or dirt within the conduit containing the conductors, has often been ignored, as well as the prevention of condensation of moisture from the atmosphere upon the walls of the conduit and the insulation, which causes frequent short-circuiting or grounding of the current and losses all along the line by leakage.

The principal object of the Petersen system is to provide an underground conduit of such construction as to effectually guard against the admission of moisture to that portion of the conduit occupied by the conductors, and to prevent the condensation of moisture on the walls or the conductors or their insulating supports. It also provides for the ready removal of any dirt which may find its way through the slot, and means for maintaining a circulation of dry, cold air within the part of the conduit in which the conductors are located.

In the accompanying illustration it will be seen that the entire conduit is divided into two longitudinal passages or compartments. The slot in the top of the casing, for the admission of the contact-carrying device, communicates with one compartment of the conduit, which is arranged to communicate at intervals with a sewer, so that any accumulation of dirt or water which comes through the slot may readily pass off. The compartment in which the conductors are located communicates with the compartment in which the slot is formed by means of longitudinal openings which are ordinarily kept closed by a movable closing device engaged by the contact-carrying arm as the car advances. This opens just sufficiently to permit the passage of the arm and closes immediately after the arm has passed. A steel broom is attached to the car and arranged to extend into the slot compartment and to sweep any dirt that enters this compartment to the sewer connections.



THE PETERSEN RAILWAY CONDUIT.

The compartment in which the conductors are located is out of line with the slot so that any water which may drip from the sides of the slot will fall clear of the wall of this compartment and also of the closing device and the slot rail is extended down at the side of the slot next to the compartment containing the conductors far enough to carry any water which enters the slot down past the opening into the latter compartment. Condensation of moisture on the walls of the conductor compartment or upon the conductors themselves or their insulated supports is prevented by the circulation of air maintained by the running of the cars, the contact carriers forming currents which, under ordinary circumstances, will, it is claimed, be sufficient to keep this compartment and the conductors perfectly dry. In a very wet climate, if found necessary, a circulation of air may be supplied to this compartment by means of a fan, but under most circumstances the inventor believes that this would not be required.

Instead of trolley wires this system employs iron or steel contact rails of considerable sectional area, as shown, divided into sections of about 100 feet in length. Each section of the contact rails is connected with the two main feeders and provided with a switch and a safety cutout device placed in the manhole, so that in case of trouble upon any particular section the contact rails where it occurs can be switched off without interfering with traffic on the rest of the line. By means of the safety cutout in case of an accidental short-circuit, the fuse will blow and thus cut out the section automatically.

The contact rails are supported upon two brackets and securely held in position by a strong insulating material, and the whole compartment is coated on the inside with a waterproof insulating paint. The main feeders are laid in metal pipes thoroughly insulated.

The contact carrier has an arm arranged to extend through the slot and provided with a lateral bend which brings its lower end into the compartment containing the conductors. This arm is provided with two contact shoes so arranged as to embrace and retain the upper part of the contact rails, and provided with swivel joints to compensate for any unevenness, and springs to keep the shoes in proper contact with the conductors. The shoes are so constructed that the car may run back and forth without making any change in their adjustment. The contact carrier arm is provided with joints permitting a motion of the arm in any direction and springs serve to hold it in its proper position while at the same time allowing it to yield freely in either direction without straining any of the parts. The contact carrier is provided with lever mechanism by means of which the motor man upon the platform may lift it out of the conduit at a manhole without delaying the car more than a few seconds.

With this system, the same cars that are used on overhead trolley systems may be employed by the simple addition of the contact carrier arm which enters the slot. This arrangement is to provide for systems where an underground conduit will be required for part of the line running through a central part of a city and where overhead wires may be used in the suburbs. The contact carrier is simply lifted from the conduit at the last manhole and held up underneath the car, while the overhead trolley is brought into use.

By this system any form of cable conduit may be utilized for the underground conductors, it being simply necessary to insert and fasten in place the partitions and the movable closing devices and to place the conductors and feeders in position.

MISCELLANEOUS.

COAL CONSUMPTION IN GENERATING ELECTRICITY.

BY

J. Stanford Brown.

IN THE ELECTRICAL ENGINEER (p. 200; p. 205 discussion and p. 206 editorial) of March 7, is given the report of The National Electric Light Association's "Committee on Data" on the above subject. The basis of comparison is a table which the Committee has drawn up showing the watt-hours per pound of coal which will be developed from a given number of pounds of coal per indicated horse-power when the engine and dynamo each have an efficiency of 90 per cent. So far so good. But does this standard reach a basis from which absolute comparison can be made?

The Committee in starting from a basis of the coal required per hour per indicated horse-power have really been starting with the coal consumed under the boiler, and stated the efficiency of the boiler in a roundabout way instead of as a percentage efficiency which they have done with engine and dynamo. Such being the case, why not assume an efficiency for the boiler and then go right back to the heat units per ton of coal burned, which must ultimately be the only standard for universal comparison? And here it is necessary that the calorific value of the coal be known. In other words with any given plant of boilers, engines, generators and wiring, the watt-hours per pound of coal will vary with the quality of the coal.

And this is perhaps one of the weakest point in central station supervision as now exercised. Too many managers do not know, nor do they usually make any attempt to find out, what calorific value their coal has. Attention has been called to the point frequently. In fact, a recent paper has stated that in a certain station in Chicago (?) the coal was paid for, not by the ton, but by the pounds of water evaporated from it.

In THE ELECTRICAL ENGINEER of March 7, 1894, p. 197, W. S. Hadaway, Jr., in an article entitled "Electric Heating and its Relation to Central Station Work," says: "A well designed central station of moderate size produces a h. p. hour by the combustion of about 3 lbs. of good coal. The electrical h. p. hour developed by this coal has 2,565 heat units; we have to balance these 2,565 heat units in the concentrated form against 42,000 heat units existent in the three pounds of coal in a more diffused state."

The subject is brought forward now, not with any idea of criticising the work of the N. E. L. A. Committee, for which all interested in central station management must be most grateful, but simply to suggest that it might be just as well to proceed at once. to what it would seem must become the only ultimate standard of comparison, in trying to find how many watt-hours can be got from any given number of B. T. Units potential in the coal pile, and one is entirely at sea with the coal table referred to above *until the number of heat units in a standard (?) pound of coal is settled.*

POLYPHASE TRANSMISSION.—II.

BY CHARLES F. SCOTT.

(Concluded.)

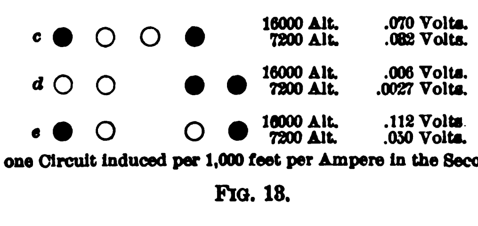
MUTUAL INDUCTION.

If two circuits be run on the same pole line they act as a transformer in which one circuit carrying current may act as a primary and induce E. M. F. in the other as a secondary. If the latter circuit is connected with the same dynamo and is delivering current, its E. M. F. will be slightly raised or slightly lowered by the effects of the first circuit. Conversely, the second circuit will have a similar effect upon its neighbor, raising or lowering its pressure by a slight amount. If the two circuits be connected to different dynamos which are running at slightly different speeds, then the E. M. F. induced by one circuit upon the other will sometimes increase and at other times decrease the E. M. F. of the circuit, depending upon whether the two currents at a given moment are flowing in the same or in opposite directions. This fluctuation may cause variations in the intensity of the lights supplied. It is readily detected in the service of some central stations, and is of course more marked at time of full load, as the induction of one circuit upon another depends upon the strength of current carried. The fluctuation due to this action may be readily distinguished from that due to the slipping of belts or irregularity in engine speed, as the induction effect is due to the difference in alternations between two machines, and the speeds of the two machines are apt to vary slightly from time to time, giving a gradual variation in the rate of fluctuation of the lamps. The fluctuation due to mutual induction of lines occurs only at the end of the line and is not observed in the station, while the other causes affect the station lights also. The number of volts E. M. F. set up in one circuit by a parallel circuit depends upon the current, the distance which the lines are parallel and upon the relative positions of the four conductors. The distance between wires may be six inches or six feet without affecting the mutual induction, provided the relative positions be unchanged. Several dispositions of circuits are shown in the diagrams, Fig. 13, and the number of volts per thousand feet at 7,200 and at 16,000 alternations, which are induced in either circuit by one ampere in the other, are given in connection with each diagram. The number of volts required for producing objectionable flickering in the light depends upon the voltage of the lamps in service, the efficiency at which they are run and the general surroundings in which they are placed, notably the relation of lamps to reflectors, white walls, etc., and the general disposition of the customer.

An E. M. F. of ½ per cent. induced in one circuit by another can in some cases be detected, and usually more than one or two per cent. will cause objectionable flickering.

METHODS OF REDUCING MUTUAL INDUCTION AND SELF-INDUCTION.

The mutual induction is reduced by bringing the wires in each circuit close together and separating the circuits. The effect of this mutual induction may be neutralized by crossing one of the lines at its middle point so that induction in the first half of the line is counteracted by the induction in the second half. It is readily noted that the effect of self-induction in a circuit is reduced as the wires are brought close together or if each conductor be divided into several wires in multiple and separated. The effect of self-induction is diminished as the number of alternations is reduced. The following points are also to be noted in connection with inductive drop. If the power factor be nearly 100 per cent. the inductive drop increases as the square of the counter E. M. F. If the E. M. F. of the circuit be increased and the same power be delivered over the same circuit, the per cent. counter E. M. F. decreases as the square of the E. M. F. delivered, and the inductive drop decreases approximately as the fourth power. If the number of alternations be decreased the counter E. M. F. decreases directly and the inductive drop decreases as the square. The inductive drop at 7,200 alternations is less than one-fourth of that for 16,000 alternations for ordinary power factors.



Volts in one Circuit induced per 1,000 feet per Ampere in the Second Circuit.

FIG. 13.

CAPACITY IN LINES.

The static capacity in ordinary lines is usually small and its effect is not of importance unless the line be very long or the pressure be very high. The general effect of capacity in the line, or of connecting condensers to the line, is to lessen the current from the generator which is required for supplying inductive load and to reduce the drop due to self-induction. The use of condensers for this purpose may lead to very considerable gains in circuits where the self-induction of line or of load becomes considerable. If an induction circuit or transformer supply current to condensers the E. M. F. may increase instead of decreasing as it does with inductive load.

POLYPHASE CIRCUITS.

The subjects which have so far been considered apply to single-phase as well as to polyphase circuits. The effects of self-induction will be brought to the attention of the electrical engineer much more prominently in connection with polyphase work, however, because larger alternating current enterprises will be carried out with the polyphase system and power work involving variable power factors will be a large element in this system. There are, in addition, several problems which relate distinctively to polyphase working. One of these is the most suitable number of phases to be used. The two-phase system and the three-phase system are both in operation, and, while it is admitted by the adherents of each system that there is no fundamental difference between them, yet each has specific characteristics giving particular advantages.

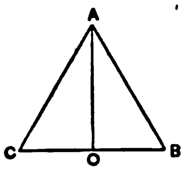


FIG. 14.

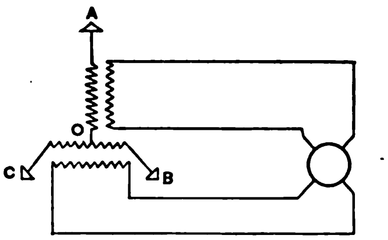


FIG. 15.

ADVANTAGES OF THREE PHASES.

In transmission it has been recently emphasized by a good many people that the single-phase system and the two-phase system require the same weight of copper, and that the three-phase, three-wire system requires 25 per cent. less for transmitting power under similar conditions with the same maximum E. M. F. This places an advantage on the side of the three-phase system which in many cases is of very considerable importance. The aggregate advantage however, is greater than 25 per cent. A two-phase system laid out for the greatest economy requires that the interest on the cost of conductors shall equal the cost of the power lost. If the three-phase system be substituted the loss may remain the same and the copper will cost 25 per cent. less. This does not give the best relation between cost of copper and loss of power, so that a more economic adjustment is evidently possible.

It has also been shown that the self-induction of a three-phase three-wire circuit for transmitting under similar conditions of E. M. F. is only 57 per cent. of that which is incident to the two-phase four-wire circuit. When the power factor is high the effect of self-induction of line upon regulation varies approximately as the square of the counter E. M. F. The drop due to the self-induction of a three-phase circuit is therefore only about one-third of a single-phase or two-phase circuit. This is a second advantage for the three-phase system which is of great value. A further advantage of three instead of four wires is the reduced cost of insulators and pole construction, the reduced losses due to leakage, etc.

ADVANTAGES OF TWO PHASES.

An important difference between the two systems is the effect of loading one branch of the system more heavily than the others, as is common in incandescent lighting. One of the statements which remain uncontroverted in Prof. Forbes' recent comprehensive and remarkable paper upon the electrical transmission of power at Niagara Falls is in reference to the difference of regulation in dynamos for two-phase and for three-phase alternating currents. He gives the result of tests showing that the circuits of a three-phase generator differ greatly in pressure if they are not equally loaded, and states that, having considered these points, the directors of the company determined to reject the three-phase system. These results agree fairly well with tests which I have made. The relative regulation of the two types of machine depends very largely of course upon the character of the construction. Although it is not just to condemn one system because a certain construction is bad, yet the theoretical and practical tendencies toward the evil are largely removed by discarding the three-phase type.

If independent regulation of circuits is necessary, one circuit can be given the proper pressure directly from the dynamo and tho other circuits may be raised or lowered as may be required. This involves apparatus for regulating two circuits if the station be operated by the three-phase system, and only one circuit if the two-phase system is in use.

In a system where incandescent lighting is to be a prominent feature, or where load of any kind may be required upon one circuit and not on the other, the two-phase system has therefore a decided advantage in station regulation over the three-phase system. Another advantage of a two-phase circuit is that the load is separated into two divisions instead of three divisions, which is in general much simpler. A further advantage of the two-phase is in the reduction of potential for motors. Two transformers are sufficient in the two-phase system, whereas three transformers are commonly used in the three-phase system. the two transformers which would be required for small motors will cost considerably less than the three transformers which would be required on the three-phase system, and the loss in transformation will be much less as there is not much difference in the cost of small transformers of slightly different sizes, and the large sizes are more efficient. The ease and simplicity of installation is also a gain for the two-phase arrangement.

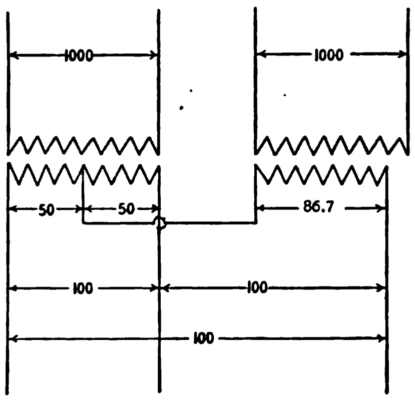


FIG. 16.

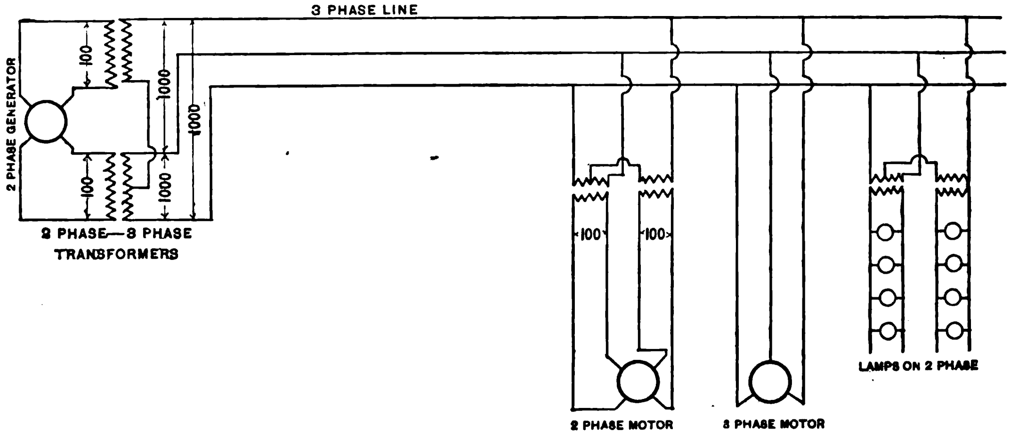


FIG. 18.

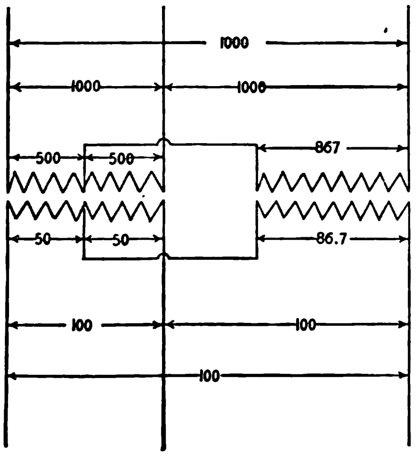


FIG. 17.

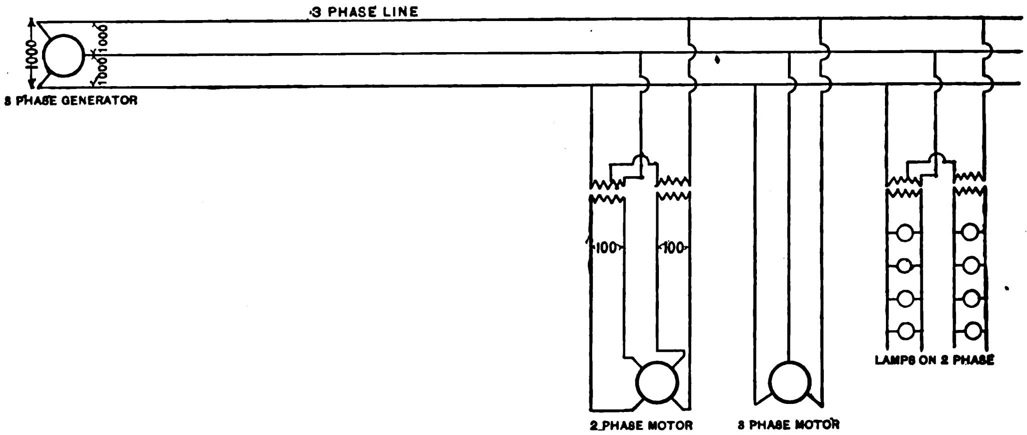


FIG. 19.

A NEW SYSTEM.

In considering the marked advantages of the two-phase system for distribution and of the two-phase system for transmission, it occurred to me that a combination of the two systems might secure the advantages of both in a combined system, and I have worked out a simple and effective method of accomplishing this result. It is well known that if two E. M. F's differing in phase be connected in series, the resulting E. M. F. will in general differ in value and in phase from either of its components. If two E. M. F's differing in phase 90 degrees be connected in series, the resultant E. M. F. is represented in direction and magnitude by the hypothenuse of a right angle triangle, of which the two sides are the two component E. M. F's. Thus in Fig. 14, if A O and O B are two E. M. F's at right angles and these E. M. F's be connected in series, the resultant is the line A B, of different phase from either of the components. It is a simple matter to so proportion the components that O B is equal to one-half of A B, as shown in the diagram. In a similar manner it is readily seen that the same E. M. F., O A, may be combined with O C, which differs from it by 90 degrees (but is equal and opposite to O B) in such a way as to give A C equal to A B, but differing in direction. B O and O C added together give B C. The E. M. F., B C, may therefore be combined with the E. M. F., A O, at right angles to it in such a way as to give additional E. M. F's, A B and C A, which, in connection with B C, give three equal E. M. F's 120 degrees apart. This is the relation of E. M. F's in the three-phase system.

The application of this arrangement to transformers is illustrated in the accompanying Figs. 15 and 16. The primaries of two transformers are connected to a generator giving two-phase current. The secondary E. M. F's therefore differ 90 degrees. One secondary is made equal to 100 turns and a loop is brought out at its middle point giving 50 turns at each side. The second secondary has 87 turns, which is approximately equal to 50 multiplied by the square root of 3. One end of the secondary circuit is connected with the middle point of the secondary of the first transformer, as shown, and the three free terminals will then deliver E. M. F's differing in phase 120 degrees. If the E. M. F. on each primary be 1,000 volts and on one secondary 100 volts and on the other 87 volts, then the E. M. F. measured between any two secondary terminals will be 100 volts. This three-phase circuit is adapted for operating three-phase motors. In a system of transmission two-phase currents at the generator may be converted into three-phase currents, as shown in Fig. 18, and the windings may be such that the E. M. F. is raised for transmission. The currents are then transmitted by three phases, effecting economy in copper. At the other end of the line a similar arrangement of transformers may be used for converting from the three-phase to the two-phase system. The two-phase currents may then be used for the operation of two-phase motors or the circuits may be independently loaded with lamps, or otherwise. If lamps be placed on the transformer which supplies directly from its two terminals the transmission is directly from the generator without affecting in any way the other circuit, as the generator terminals are connected directly to the first primaries, and the secondaries of the raising transformer are connected directly to the primaries of the lowering transformer and the current from this is taken directly to the load. On the other hand, if the other circuit be loaded the action here will also be on its own generator circuit without affecting the first. The current from the raising transformer in this circuit passes to the middle of the secondary of the other transformer, where it divides and flows in parallel through the two parts of the coil and two of the lines. As one-half of the current flows through each part of the secondary coil in opposite directions, the self-induction is completely neutralized and the transformers in this circuit are independent of the operation of the other circuit. It is to be noted that under this condition the line E. M. F. delivered by this transformer is only 87 per cent. of that delivered by the first transformer. The lower E. M. F., however, is compensated for by the fact that the current on one side is passed through two of the lines in parallel, thus reducing the resistance of the circuit, and compensating for the slightly lower E. M. F.

The effect upon the regulation of the generator when two-phase circuits at the end of a three-phase transmission line are independently loaded is found, both by theory and test, to be the same that prevails when the load is placed directly upon the corresponding circuit of the generator. A modification of this system is found in the arrangement where the three-phase current is produced in the generator and transmitted over three wires to the reducing transformers. These transformers may be arranged as described for producing two phases (Fig. 19). Loads may be placed upon either of the two-phase circuits and practically the same regulation in the generator will result that would have resulted if the generator itself had been wound for two phases and one of these circuits loaded. In this way it is possible to place a a lighting load upon a three-phase generator in two instead of three units and to avoid the bad regulation in the generator due to unequal loading.

A similar arrangement of two transformers may be used for converting three phases of one potential into three phases of another potential. This arrangement is shown in the accompanying Fig. 17.

The efficiency of two transformers arranged for converting from two-phase to three-phase is reduced below that when working independently on ordinary loads by an insignificant amount. If the efficiency in ordinary working is, say, 97.5 per cent. it would be reduced to 97.4 per cent. in converting from one number of phases to the other.

The Tesla polyphase system in which the largest electrical enterprises are seeking a realization, adapts itself with marvelous facility not only to all branches of electrical industry, but also by the transformation of its phases to the utilization of three phases for gaining the highest economy in transmission, and of two phases for securing the maximum advantages in distribution.

DISCUSSION.

The President introduced **Prof. Forbes**, who addressed the meeting as follows:

Prof. Forbes:—I would like to say a few words simply to express the admiration I am sure everyone has felt for the great ingenuity which Mr. Scott has displayed in working out this beautiful arrangement of a combination of the two-phase and three-phase systems together. We must all admit that it is an extremely beautiful idea and appears on the face of it to be a feasible method. With regard to the practicability of it, I think Mr. Scott will agree with me that it must be left to the test of experience before we can say whether it is a satisfactory method of working—as satisfactory as the two-phase or three-phase systems separately. On the face of it, it looks as if it were so.

I confess I do not appreciate so much as he seems to do the superior advantages of the three-phase system for transmission over long distances. It seems to me that the two systems, so far as we can find out in practice, as to their economy, etc., have little advantage one over the other. If the opinion be right that the three-phase system has a distinct advantage over the two-phase then such a scheme as Mr. Scott's ought to prove of great value. I am sure that if there are any members of the Convention present who are devoted to the direct current system and determined never to hold any other opinion whatever may happen, they will be extremely pleased to learn all the apparently intricate calculation and investigations that have to be made by the ordinary electrical engineer in dealing with the alternating current; but as a matter of fact many of these problems and apparent difficulties of calculation to which Mr. Scott has alluded do not become very important in the ordinary electric lighting, or power station work with alternating currents of moderate dimensions. But these matters of the self-induction of the line, and the influence of different circuits upon each other, become of the very utmost importance when we are dealing with the transmission of power over great distances and on a large scale, and carrying a large amount of current through our mains. I need hardly say that in the course of the last year or two in connection with the transmission of power at Niagara it has been my duty to go into these points that Mr. Scott has touched upon, very fully indeed; and in a large problem like that the importance of these incidental matters to the alternating current, the dropping volts, the self-induction of the loop circuit of the line, etc., are so important that one cannot spend too much time in investigating them prior to the establishing of the plant. I have in the course of this work prepared for my own use a variety of tables and curves illustrating the effects and enabling one to get the results in a particular case at a moment's glance, and it has been my purpose to publish these tables and curves for the use of others; but Mr. Scott has gone a long way to make this unnecessary.

I would particularly thank Mr. Scott for this diagram which shows the inductive electromotive force in volts per ampere per thousand alternations per thousand feet of circuit at different distances between the centres. I think if we take this paper of Mr. Scott's in conjunction with those which have been written by Mr. Kennelly on the same subject, any engineer has got before him all that is required for calculating the effects of self-induction and capacity upon the circuit; that is to say, upon the efficiency of the circuit and upon the drop of volts on the circuit. A little more has to be done, however, and that is the effect of reasonance—capacity—and self-induction. There is a case which we have to consider and which is of the utmost importance. However, Mr. Scott has spoken of the interference of separate circuits upon each other. If he had considered the question of two different circuits, one circuit being a quarter of a period behind the other then we have a very serious interference. Suppose this circuit is changed from positive to negative. At the moment when it is zero there is a maximum electromotive force cutting the field and that maximum electromotive force cuts the other conductors which carry the current a quarter of a phase behind, at the very moment when that current is at its maximum. Therefore the E. M. F. induced by one circuit upon the other is in phase with the current in the other conductor, and the result is a drop in the E. M. F. of the other circuit. For this reason you will see that it is most important in a large station where the polyphase system is employed to consider most carefully the arrangement of the conductors in your subways or on your poles. This interference between the two circuits is of very great importance, far more important than the self-induction of one of the circuits upon itself. The lower the frequency the less the trouble from this cause, and hence the adoption of 20 periods per second at Niagara.

Prof. Forbes concluded by saying that the Cataract Construction Company and himself did not propose to take the slightest notice of the numerous fault findings and mis-statements that had at different times appeared with regard to the work at Niagara, as they were confident of the final result.

Prof. H. A. Rowland said that so far as he could see, Mr. Scott's invention was one of the finest things that had come out in recent years in this country. Very few of us expected that we would be soon able to transform a two-phase system into a three-phase, or any number of phases; it gave us possibilities in the working of motors, etc., and the paper marked an era in the science of the polyphase systems. He had himself been working on a paper covering the same points, but his method, though a little broader, was not in any way so practical and simple as that of Mr. Scott's. By his method he could change the period of the current at the same time that the number of phases is changed.

Although he quite agreed with Prof. Forbes that a low period was excellent in many respects, he was not able to agree with him as to the exact figures; when one got down very low, things happened that would not happen with a reasonable frequency. He saw no reason for lowering the frequency in the Tesla motor, as good motors could be made for a reasonably high frequency as for a low one. With transformers, however, the higher the period, the better the transformer becomes; and the smaller the period the larger the transformers, etc.; so that there is some limit to the question of frequency.

Mr. T. Spencer inquired how Mr. Scott would apply that load factor when the load is distributed along the line, so that one could get an accurate idea of the size of the conductor or percentage of drop in the line.

Mr. Scott replied that in that case the problem becomes more complicated. It would be necessary then to take each part of the circuit and calculate the amount of electromotive force in it, and so on, for each part of the circuit. In practice, however, the counter electromotive force in primary circuits of one or two thousand volts extended over a small area—a mile or so—and with ordinary currents, up to one hundred amperes, was not such as to cause effects of very great practical importance. That was shown from the fact that in the circuits ordinarily operated, these effects had not been very prominent. They had not interferred with the working of central stations of pretty large capacity, and the fact was fully demonstrated at the World's Fair Westinghouse incandescent lighting plant which had been the largest ever installed. In general, the inductive drop in circuits for incandescent lighting was only a small percentage of the ohmic drop; and it was an extreme case when the drop due to induction equaled the drop due to the resistance of the conductor. He agreed with Prof. Forbes on the great value of Mr. Kennelly's paper.

In ordinary working, however, capacity would have very little effect. It was only when we got up to very high voltages or very low lines that the effect of capacity would enter in a marked degree. The so-called skin resistance, or increase of resistance of the conductor, due to the un-uniform distribution of electric currents in ordinary working may be very largely neglected. This effect decreases as the number of alternations increases, so that with sixteen thousand alternations the increase in resistance in a conductor half an inch in diameter is only three per cent. or thereabouts, so that ordinarily this is an insignificant amount. In order that the resistance shall not exceed this, with low alternations (three or four thousand) the diameter of the wire must be something like an inch or an inch and a half.

Mr. L. B. Stillwell complimented the Association in having had such a valuable paper brought before it. He claimed that the plans at Niagara Falls were substantially those laid out by Mr. Tesla several years ago, and referred to the statement of the Westinghouse company's position in the matter published in The Electrical Engineer of Jan. 10, 1894. He also referred to the Westinghouse plant at the World's Fair as exemplifying the general type of the system adopted at Niagara.

Prof. Rowland corroborated Mr. Stillwell.

HOW TO OPERATE A STEAM BOILER.

BY JARVIS B. EDSON, M. E.

The engineer of the present day begins his operations based upon the pressure of steam he is capable of maintaining in his steam boiler. From this he extends his calculations, and elaborates his plans for the prosecution of his work. It matters not what the problem may be,—whether it is the grain to be threshed, grist to be ground, hill leveled or mountain pierced, ore raised or office reached, ocean ploughed or continent crossed,—the same agent performs them all. The tropical fruit while rushed to a Northern market is also cooled by it, and the plenteous meat of the Western plain is refrigerated during its trans-continental run, and we see the coal transformed into heat, then into steam, and finally manifesting itself in work, in its production of cold exemplifying the beautiful law of the conservation of energy, and making us thankful for the birth of steam. At present the civilized world is lighted by electricity, and searching for one greater than Faraday who shall give us a substitute for, and sound the death-knell of steam. So meanwhile we reconcile ourselves to the loss passing up the chimney, and stand aghast when the boiler "lets go," scattering death and destruction in its wake, and simply conclude with a verdict of "nobody to blame."

Investigation and scientific study have done much, however, both for the construction and the safe and economical management of steam boilers. Mystery no longer accounts for their explosions, for the conclusion has been reached that "the causes of such accidents can be wholly prevented and controlled," and ignorance is becoming dethroned in her sway, to make way for the more intelligent methods of boiler management. The men from our colleges and technical schools demand the facts, that they may proceed to their conclusions. Not theirs to view the one hundred victims of a "Westfield" explosion with "nobody to blame;" for it is not they who beat upon pans, and blow horns, to scare off the devil when the sun darkens. The solar eclipse to them was calculated upon, and predicted in advance of its coming. Their verdict will always be: "Somebody is to blame;" "Explosions are caused by ignorance or neglect."

And so with economy, for to them the furnace will be a sort of gas retort, and the burning of coal a scientific study. To them, the boiler is a giant struggling against almost equal odds, harassed by conflicting expansions and contractions, constant and varying strains, attacked by corrosion and injured by scale. They well know it as a magazine of enormous power, in which each cubic foot of water has the explosive energy stored within it of a pound of gunpowder, and to them eternal vigilance will be the price of safety. Certainly, then, it does appear strange that for such a charge we should employ cheap labor, and that the most important man about the establishment is the favorite fireman. For my part, it is incomprehensible how either practical men or those of the usual amount of business sagacity can feel willing to discount the chances against such a course. Nevertheless, the engineer of to-day is confronted with these conditions, and the safety and economy of his plant become of imperative importance to his success.

Upon the question of safety, it requires no demonstration to prove that whatever impairs the boiler's strength or durability should be prevented. To make such prevention possible, however, presuppose the means whereby the preventable occurrences may become known. If, therefore, fluctuating or excessive steam pressures are injurious, how are we to be made aware of their occurrence? Obviously but one method exists, and that is, the resort to automatically steam-written records of them, from which we can determine the departure from conservative limits. Assuming that the ordinary steam gauge, which only indicates the pressure at the instant, is entitled to the great confidence bestowed upon it, it undeniably lacks the ability to afford us any more information as to the pressure of the previous moment than the proverbial dead man who can tell no tales. In fact, for many years, owing to sharp competition, they have been so poorly constructed as to be even dangerous to use, so liable are many to rely upon them for the determination of the pressure they are at the time carrying, even going so far as to adjust their safety-valve weights to blow with the gauge. The dials are first produced by different methods, in large quantities, all alike, and the springs taken afterward which will come the nearest to the "travel" called for by the dial so laid out; whereas each spring has its own "travel," and its dial should be laid off accordingly, and a suitable price demanded for the article when made. A cheap and unreliable steam gauge is dangerous and dear at any price.

When, however, only one of these is relied upon for twenty years, it is apt to be considerably out. Instead, therefore, of relying solely upon the ordinary indicating instrument, whether it be entitled to such confidence or not, common prudence would dictate the employment of more than one gauge, and preferably that the supernumerary should be a recording machine. The records of steam pressure carried have a large prudential value, for the reason that, with their use, a fireman must give up his position, or do what he is required to. For instance, if a careless man lets his steam get too high before he discovers it, and the "safety-valve" (?) does not blow as calculated upon, from any of the causes common in such cases, who other than the fireman will be any the wiser? And when will the remedy for a careless fireman, or faulty, overloaded safety-valve, be applied?

It is generally supposed to be necessary to first *know* of a trouble before its remedy can be either determined or applied. The only way, therefore, to know whether one's boilers are being exposed to excessive pressure or not, is to use a guage which records the pressure. Occurrences are constantly taking place under that smooth-sounding term "banked fires" which would electrify every hair of one's head if revealed to those who have so much at stake, and think such a fire harmless. A strong fire towards stopping time leaves the boiler setting so hot as to supply sufficient heat for running up the pressure beyond what a cold setting could do. Yet, when the fires are once "banked," the man "lets up" on his watchfulness, and generally the boiler is left entirely alone for a long interval. "We never carry steam at night, as we bank our fires, and in the day-time have a good, careful man around," is an expression common to most steam users; but a few moments will generally convince them that they have assumed a very ridiculous and untenable position. The police of our cities frequently find steam blowing off from a boiler under the sidewalk during their night perambulations, and have learned that it means one of those places where they "never carry steam at night"; and they rout out somebody in the building or neighborhood to remedy the trouble. A case occurred some time ago, under one of the costliest buildings on Broadway, New York, where fires are banked, and they "never carry steam at night." It appeared, however, from the Edson recording gauge chart tne next morning, that something had caused the recorder to make a high-steam line for a good part of the night, and investigation proved that the night watchman heard a roaring noise when in the top of the building, and concluded it must be the boiler "blowing" about something; so he clambered down twelve or thirteen stories, and found the damper closed, and a full pressure on. Of course it goes without saying, that if the safety (?) valve had been fast in its seat, as it frequently is, or the weight shifted on the lever from any cause, a first-class explosion would have followed. The boilers are provided with an approved pattern of damper regulator on the main flue, and also have individual dampers on the branches from each boiler leading into the main flue. The individual dampers are, of course, for shutting off either boiler when not in use. The trouble was caused by the fireman not knowing enough, or forgetting, to unhook his automatic regulator connection before leaving for the night; and so when the banked fire and heated walls had radiated sufficient of their heat, the pressure of steam closed the damper, and the heat being entirely shut in, and no cold-air passage left open to the chimney, and little or no steam being used in the building, the safety-valve was called upon, and fortunately did its duty, and prevented the steam passing beyond the limit, as shown by the chart.

In the same establisment, only two months later, on New Year's morning, the night watchman closed the furnace doors at the usual hour, so the fires would be in better condition for the day fireman when he arrived; but the day man did not arrive until some two hours later than usual, as it was a holiday, and so the steam went up again, and startled the neighborhood with the racket for an hour or so. The day man claimed that he told the watchman not to close the doors until a later hour, which the latter denies. Be it all as it may, in both instances the chart daily submitted to the manager of the property revealed the occurrences, and brought forth an investigation resulting in more correct methods of transmitting orders and causing the unhooking of the regulator while under "banked fires," and also in the night watchman making more frequent visits to the boiler room. Who can deny that in this instance their indifferent methods would ultimately have resulted in exploding their boiler, had not the Edson recording gauge unmasked the facts, and caused the proprietor to set some needed rules in force? If an ounce of prevention is better than a pound of cure, the instrument repaid its first cost in these two instances alone.

Self-interest should suggest the use of such a safety appliance, particularly inasmuch as all persons are supposed to intend the natural consequences of their acts; for proof of an act or course of procedure which was adopted or persisted in to deceive the public, or in defiance of its safety, is sufficient proof of the intent to deceive and jeopardize, unless the doer establishes innocence of such intent and knowledge, and the burden of proof rests on him. If, therefore, it be true that no steam-boiler plant can be conducted as intelligently, economically, or safely without the information and aid supplied by the pressure-recording instrument as with it, then proof of negligence can be made out by establishing the fact that such a valuable monitor and means of information as the pressure-recorder had been rejected, and failure to secure such competent attention may properly be urged in Courts of law as evidence of negligence.

Even so important a matter as the amount of pressure applied by an authorized inspector in testing a boiler with hot water, has shown that only an excess of eight pounds was put upon an old boiler which is regularly carrying from fifty-five to sixty pounds pressure of steam. The record further shows the pressure to have been "jumped on" for an instant, and then released, allowing no time for careful inspection of the seams, etc., while under the testing pressure. No satisfactory reason has been obtained, so far, for this improper method of testing; but the fact has been established, and so much gained. Certainly more confidence could be reposed in a test where the record shows that the boiler sustained the testing pressure for five or ten minutes, and during which time the testing engineer could be presumed to have been examining the boiler for evidence of effect under such strain.

Another matter revealed frequently by the Edson recording-gauge chart is the habit, indulged in by many attendants, called "bottling up steam." The most frequent occurrence of such habits takes place at a few moments before the starting time in the morning and at noon, and in some cases just before cleaning fires. Of course such prejudicial habits are the simple outgrowth of ignorance concerning the limited amount of steam in quantity they can so bottle up, and the very small service it can render, compared with the injury such practice, when persisted in, ultimately does the boiler. Aside from this objection, the habit is exceedingly pernicious, because only a few moments' neglect would cause the pressure to accumulate to the point at which the safety-valve is supposed to open; then, if it happens to be inoperative, an accident is almost certain to follow. No excuse should be taken in any shape, under any kind of reasoning, for "bottling up steam," If the generating capacity of the boiler is not equal to the current demand, it cannot be helped by simply bottling it up; in fact, it has been my experience, that where the record line has been extremely crooked upon the first introduction of the recorder, the effect of such introduction has been to cause a much more uniform line from day to day, until the nearest approach to uniformity had been reached, consistent with the vicissitudes of the demands for steam. A steam user once apologized for the appearance of his record, saying that the steam was drawn from the boiler at irregular periods by persons in the mill, and consequently the firemen could not carry any very regular line; that his use of steam was different from that in most places, etc. Noticing, apparently, my incredulity he asked if I disagreed with him. My reply was: "Do you suppose that the steam necessarily falls as low as this record indicates?" In other words, I called his attention to the fact, that, where a fireman is on the keen look-out for his boiler pressure and water level, he will readily detect the pointer-hand of his gauge the moment it begins to rise or fall, and govern himself accordingly. For instance, if he sees the hand indicating that the pressure is falling he will avail himself of the opportunity to slow down his feed, and perhaps open his damper wider, and, if his fires are in prime condition, withhold fresh coal for a few moments; then when the onslaught upon his boiler has ceased, and the hand of his gauge is stationary, or starts to move upwardly, he will at once set about it to replenish his coal and water, and so have his conditions favorable in a few moments for another attack upon his steam supply. When his steam is rising, he can afford to feed and to fire, and his thought should be to have everthing in prime condition while he had surplus power and opportunity. Then he would not be caught so badly when these extreme attacks were made upon him. The cause of these extreme fluctuations, then, are largely due to the fact of his being unprepared to meet these emergencies, and, becoming alarmed when his steam has fallen twenty or thirty pounds, he attempts to get it up by replenishing his fire, as it seriously needs it, with coal, which only tends for the time being to reduce the pressure still more, until it has been capable of delivering its gases, ready for combustion.

After this little explanation, the proprietor shook his head, and said he never had thought of it in that light, and that he would have to call John to him, and have a talk with him. Now, the result of this was, that, from that time on, the man's record never fluctuated in the same manner again, and the average steam line maintained was one which showed constant attention to firing frequently in small quantities, and keeping himself in shape to meet these emergencies. Undoubtedly, the man had to work a little harder at first, but afterwards it was easier when he properly understood the matter, and manipulated his fires accordingly. The suggestion from the proprietor was exceedingly valuable. It resulted in the proprietor teaching his man, and in mutual regard between them afterwards, because it showed that the man was capable of being taught, and also willing to be, and that the proprietor had evidence of the resulting fidelity. The dissemination of knowledge among firemen can certainly do no harm, and when it reaches a man who desires to hold his position, and give satisfaction, it will do much good.

Men uneducated to the science of what constitutes firing steam boilers, can hardly be expected to use that knowledge which others possess professionally. Some men will fill a furnace full of coal, so as to have more time to walk around; then after a time up goes the steam pressure, because more heat is generated than is wanted; then the feed water is turned on, and the water level run up so as to keep the steam pressure down; the safety-valves may blow or not, the damper is closed, the fires smolder, large quantities of carbonic-oxide gas go up the chimney, and this means an escape of unconsumed fuel, which means dollars and cents. After a while the fires burn lower, and down goes the steam—helped down, it may be another dose of coal; and so we can imagine the final effects upon boilers used in such a manner. The position of a fireman may be considered an humble one by some people, but he is a man for all that, and his pride in what he can do is a stronger spur than anything else. Let him see that you care for what he is doing, and take a careful interest in his work, and let him understand furthermore that his own grading depends upon himself, as established by his records; then you are in a fair way to have confidence in your man and in your safety, and also feel assured of economy of fuel. But eventually you must pay him what he is worth. If not, some one else will be glad to have him. Suppose, for instance, a man who burns three tons of coal a day is paid two dollars for such service, and that in so doing he is wasting as little as ten per cent. If coal costs four dollars and a half per ton, the loss will be one dollar and thirty-five cents per day, or what is equivalent to paying a man three dollars and thirty-five cents per day who can save this amount; but when amounts of, say, eight thousand tons per month are used, the saving of only ten per cent amounts to eighty dollars per day, and a small portion of which, if offered as a premium to the men who use this coal, would go a long way towards saving the remainder of this money.

What is wanted is the maximum of steam per dollar's worth of coal burned! Much can be saved by the manner of its use, and it is within limits furthermore to say that from five to ten per cent. is commonly wasted, while from thirty to forty per cent. is frequently gotten rid of by firemen not qualified as such, and entirely ignorant or indifferent regarding the science of complete combustion. Certainly it is of vastly more importance to a proprietor, both on the score of safety and economy, that his fireman shall be a man trained in the art of properly burning the fuel supplied him, than that his engineer shall know particularly if the latter does not impart the information to the fireman. The practical value, therefore, of the steam record is, in this connection, that it compels the fireman to give close attention, maintain uniform water level and uniform steam; and these cannot be had with anything short of the closest scrutiny, which means economy of fuel, and safety as well. The explanation of the charts has given much information touching unexpected occurrences, but innumerable other instances might be recited which would only tend to exhibit the surprisingly large number of unsuspected occurrences possible wherever steam is used; and as these facts become more generally known to those who are not at present deriving the information from such instruments, their use will be extended, and more correct methods of caring for steam boilers under pressure will be inaugurated, ultimately resulting not only in greater economy of fuel, but in a greater degree of immunity from those disastrous explosions which destroy so many lives and so much property annually.

MR. HAMMER'S LECTURE ON "ELECTRICITY."

On Wednesday, Mar. 7, Mr. Wm. J. Hammer delivered a lecture on Electricity before the Dryden Literary and Musical Society at Newark, N. J. The lecture consisted of quite an elaborate series of experiments in electricity and magnetism and in the appliances of electricity to lighting, power, telegraphy, telephony, war purposes, balooning, electric heating and cooking, storage of electricity, etc. Some interesting experiments in radiant matter were also shown, and the large stage was filled with an extensive collection of interesting apparatus used in the lecture. Large diagrams were hung on the walls to illustrate the apparatus referred to. Mr. Hammer was ably assisted by Mr. Frank Lawton, and Mr. E. J. Cabot.

WACO, TEX.—The Electric Railway and Light Company was placed in the hands of a receiver on Feb. 26th. The assets are given as $800,000 and the liabilities are placed at only $200,000.

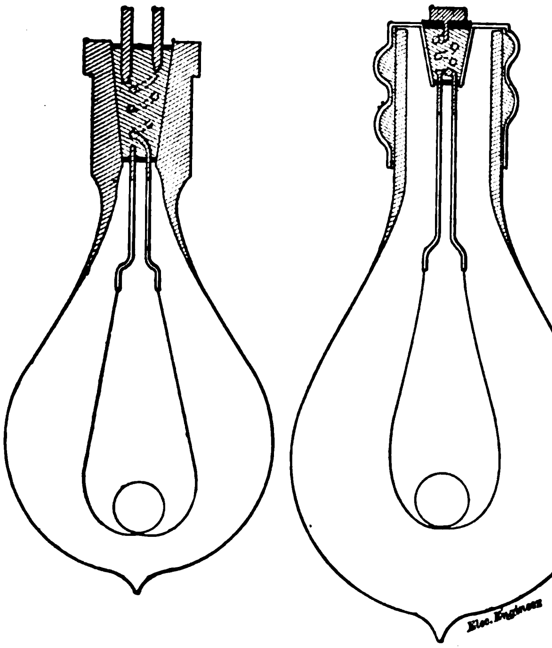
THE MAC FADDEN-PEIL INCANDESCENT LAMP.

The accompanying engravings illustrate the method of construction of an incandescent lamp recently patented by Carl K. Mac Fadden and John Peil of Chicago, which, according to the inventors, is not only clear of all existing patent claims, but also covers several new features tending to reduce the cost of manufacture of incandescent lamps.

The main feature consists in utilizing the insulating properties of a thin coat of enamel on the inleading wires which are let into the glass receiver through a metal seal around the wires. To insure a perfect seal, the inleading wires are wound in a spiral form before they are given their coat of enamel and the seal is thus made two or three inches in length in a metal plug of small size.

Fig. 1 shows the principle as applied to a lamp using a bulb having a heavy moulded base. One terminal of the filament is the metal plug or seal, thus doing away with one of the inleading wires and simplifying the construction to some extent. After the seal is made by pouring melted alloy around the wire as it stands in place in the space to be filled by the metal seal, a small quantity of cement is poured over the top of the metal stopper, which cement soon hardens and makes a perfect seal.

In Fig. 2 the same seal is used, but it is in this case made in an inleading flange in a metal cap, which, when closed at one end by a mica disc, leaves a space to be filled by a tapering plug which contains the seal for the inleading wires. The cap is so made as to have a spiral corrugation on its outer surface and can thus be used in Edison sockets as commonly made.



FIGS. 1 AND 2.—THE MAC FADDEN-PEIL INCANDESCENT LAMP.

The alloy seal used in all cases has the property of expanding slightly as it solidifies and as it is poured in around the wire in a melted state, grips the wire tightly as it cools. In the second case shown, the seal unites to the surface of the metal cap in a thorough manner. The metal cap is enameled on its inner surface and in this manner the cement really unites the glass surface of the cap to the glass neck of the lamp bulb. The cement used softens at about 400 deg. Fahr., and in this case will allow any unequal expansion of the metal cap and glass bulb to take place without injury to the seal. The cap may be readily removed by placing the base of the lamp over a glass jet, when the heat will soften the cement, and the cap and bulb may be separated.

The caps and enameled wires are cheap to manufacture, and the sealing up of the lamps can be done in a rapid and yet perfect manner. It will be readily seen that the use of platinum is entirely done away with, and that the lamp is thoroughly waterproof, having no plaster of paris or other absorbent insulating material in its construction. The cost of manufacture in quantities has been variously estimated from 2 to 6 cents less than that necessary to make all-glass lamps of the usual type.

Mr. Luther Stieringer has gone to California for a vacation, and while there will visit the Midwinter Fair, where one of his World's Fair electric fountains has been set up and put in operation with quite fine effect.

LETTERS TO THE EDITOR.

THE PURPOSE OF PATENT SYSTEMS.

In these days of patents owned by great monopolies to whom the public is paying enormous prices for the use of the patented articles, and of injunction suits for infringement of patents for so called inventions of appliances that any school boy would have made when first he felt the need of them, we are apt to forget or lose sight of the original purpose of the patent law, and come to the conclusion that its only object is to permit some great monopoly to secure and maintain control of supplying the needs of the public for some patented device. Of course we know perfectly well that the primary purpose of the patent system is to stimulate invention by securing to the inventor a substantial reward for his work. The public is always looking for something new, some new avenue for labor or enjoyment, or some better or cheaper way of pursuing the old avenues. It says to the inventor: Benefit us in some substantial way, and we will secure to you the means of deriving a suitable recompense for year time and labor. The object is *mutual* benefit, and it seems to me that any law that fails to secure to the public the use of a new device while securing to the inventor his reward or that secures to one man or company the right to furnish a device that a hundred concerns would have been ready to supply as soon as it is wanted is radically defective.

Under our patent laws any one whose business might be injured by the introduction of a new device, may secure control of the patent, lay it aside and refuse to allow the article to be manufactured at all. He pays the inventor a price agreed upon for the patent, the inventor therefore gets his reward, and the public pays that reward by paying to the purchaser an unnecessary profit on what he has to furnish. Where is the benefit to the public in this transaction?

The law that secures to the inventor his reward, should also secure to the public the benefit of the invention. A patent that has been shelved should become public property.

It is the law in some countries that a patented device shall be put upon the market within a reasonable time, and this is an eminently just provision. The patent law defeats its own purpose as far as the public is concerned if it permits the shelving of a patent for the benefit of an individual or corporation.

The question, What constitutes invention? is a very difficult one to answer and different individuals might answer it very differently, and yet I cannot agree with the conclusions arrived at in a recent paper on this subject, that the question should not be considered in passing upon an application in the patent office. In that paper it was urged that every application should be granted if the device was new, that no injustice could be done by allowing the patent, even if it were plain that no invention was involved. There are two parties to a patent, the public and the inventor. If a patent is granted for a perfectly obvious device, it is equivalent to granting a monopoly for the furnishing of that device, and that monopoly can only be broken by an expensive legal process. Is it not an injury to the public to create such a monopoly where it is not deserved?

To illustrate: Suppose in the early days of sheet iron stove pipes some one carried such a pipe through a wooden partition, and, thinking that at such a long distance from the stove it could never become hot enough to do any harm, leaves it without protection. It does become hot enough, and sets fire to his building. Then someone says: "That stove pipe should have been provided with an incombustible jacket," and at once applies for a patent. In the early days of arc lighting, a lamp suspended by a fibre rope may have fallen and perhaps done serious injury. Someone seeing it says: "That rope was not strong enough, it should have been a wire rope," and immediately applies for a patent for the suspension of arc lamps by wire ropes. Securing his patent he applies to the street commissioner and induces him to issue an order that all arc lamps on the streets shall be suspended by wire ropes. Have these men conferred any benefit upon the public? Did not the man who first put up the arc lamps know that a wire rope was stronger than a fibre one; and was it anything but an error in judgment that led him to use the less costly material? It may seem absurd to cite such illustrations, but patents have been granted and suits for infringement have been brought in almost exactly parallel cases. Patents have been granted for old devices in which only changes of proportion had been made involving nothing but engineering skill.

Some inventors are always looking ahead and applying for patents on simple devices in anticipation of the public needs. Hearing of such an application about to be filed the writer asked if the device described would not be the most natural and obvious thing to use when a case occurred where something for the purpose was needed. "Yes," said the inventor, "and that is just the reason for applying for a patent now. If you wait until the art has advanced to the point where such a device is needed, there will be a thousand men to think of this very thing." Is it the purpose of a patent system to reward such foresight as this?

Numerous combination patents have been granted covering the use of old and well-known devices in, perhaps, new but perfectly obvious relations. A magneto call arranged to be switched in and out of circuit is claimed in combination with telephones and telephone circuits. As I remember my own doubts in 1877, as to being able to use telephones on a private telegraph line in consequence of the self induction of the telegraph instruments, and as I knew, whether the telephones could be used or not, that it would be *better* to cut out the telegraph instruments while the telephones were in use, and as there were several obvious ways of doing this, cannot see any invention in applying to a telepho ne circuit any electro-magnetic device arranged to be cut in or out of circuit. A patent might properly be claimed on the particular device for cutting the magneto in or out, but a claim for the combination of that device with a telephone circuit of absurd. So with the claim for the combination of a plug switch with telephones and battery. Plug-switches had been used on telegraph circuits for years. What invention was involved in the use of them on telephone circuits? In fact I used such switches for telephones a year earlier than the date of this patent and it never entered my head that I was inventing anything.

Such cases as those cited above are not uncommon among patents issued from our patent office. The patentee in such a case confers no benefit upon the public; he discloses nothing new. The mere fact that he was the first to do a thing, if he was the first, does not show that others did not know how to do it, or could not have done it had occasion called for it. Why should not such applications be refused as involving no invention? I am well aware that I shall be met by a statement of the great difficulty in determining what involves invention. It will be pointed out that it is very easy to do a thing after we are shown how to do it. The old story of Columbus and the egg will no doubt be cited, and it will be said that it is better to err in favor of the inventor than against him. In regard to the egg story, I wish to point out that Columbus *did not* solve the problem. The problem was to balance a whole egg, not a broken one.

I admit the difficulty in determining what is invention and am willing to give the inventor the benefit of the doubt where reasonable doubt exists; but there are cases so plain that no serious question could be entertained, and to ignore the question altogether, and allow a patent for every thing asked for provided it had not been done or described before, is to do an injustice to the public which has at least some claim to consideration.

The invention of ice machines conferred a great benefit for which the public should be willing to pay handsomely. But if some one, seeing that the time was coming when skating ponds would be artificially frozen, should apply for a patent on a combination of a pair of skates and a sheet of artificially frozen ice, which would, if granted, compel the public to pay not only the inventor of the ice machine for the ice, but the "inventor" of the combination for the privilege of going on it, I think the examiner would be fully warranted in rejecting that application.

A serious question in connection with the patent rights relates to the charges to the public for the use of the patented article. A valuable patent should yield to the *inventor* a handsome return. He must defend his right to the exclusive manufacture and sale of his device and may, therefore, be put to great expense; but considering all those things, should the public have nothing to say as to the price to be charged for a patented article? It is said that an inventor's ideas are his own property; that he should be allowed to put upon them such a price as he pleases, or refuse to sell them at all; that the public need not, and will not, pay more than the device is worth to it. But it must be remembered that it is a very rare thing that ideas come to one man alone. While one may appear first at the Patent Office, dozens of others may have conceived the same ideas and be just as truly the inventors of the device as he. It is necessary that, in securing to the first arrival the exclusive right to his ideas and in denying to the other inventors any opportunity to compete with him, the public should place itself entirely at his mercy?

I know it is impossible to secure ideal justice in the treatment of these questions. The public wishes to reap the benefit of all the inventive genius in its midst, and to stimulate invention desires to offer prizes so tempting as to call forth the best work of the highest talent. But it is not a part of its purpose to deprive itself of the use of valuable improvements for the benefit of some corporation whose business might suffer by such use; nor is it its purpose to be hampered in the use of devices whose production does not require inventive talent. As I have said, it is, probably, impossible to secure absolute justice to both the inventor and the public, but the laws might at least be so framed and administered as to reach such obvious cases of injustice as I have exemplified.

W. A. Anthony.

Vineland, N. J.

THE STORAGE BATTERY CHALLENGE TESTS.

In reply to the questions raised by Mr. Robert McA. Lloyd appearing in the correspondence columns of your issue dated March 14 we beg to submit the following particulars.

(1.) In regard to the 50 per cent. superiority, we have decided that the only fair interpretation of the challenge issued by the Electric Storage Battery Company in their published letter of March 2 is, that the percentages of superiority which tests may show in efficiency, capacity, and durability of their batteries over other batteries must amount in all to 50 per cent. as contained in the 10th clause of our schedule.

(2.) By "dry electrode as shipped," we mean the complete positive and negative plates together as removed from their containing cell.

(3.) "Dry electrodes as shipped," does not include electrolyte.

(4.) The one hundred preliminary discharges will be carried to the limit of 1.75 volts E. M. F. per cell.

(5.) It is usual to carry secondary battery discharge tests down to 1.75 volts E. M. F.

(6.) The point of full charge for any battery is to be arranged by correspondence as stated in the 6th provision of our schedule. "The criterion of full charge to be agreed on in writing before the test is commenced in each case."

We shall be pleased to give any further information by direct correspondence to Mr. McA. Lloyd, or any other party.

Houston & Kennelly.

Philadelphia, Pa., March 15, 1894.

WHAT ARE WIRING RULES MADE FOR?

In the January issue of the *Architects' Electrical Bulletin*, issued by the Interior Conduit Company, there is an editorial article relating to the question of fire underwriters' rules and asking why it is that rules are not enforced. It has come to the attention of the writer lately that one of the most glaring violations of the rules of the underwriters is shown in the wiring of the Temple Court Building, corner of Beekman & Nassau Streets, and as a sample of the way rules are not enforced, and the way that the electrician of the underwriters allows and sanctions a forbidden work is something remarkable, and it is worth a trip to inspect this work and see just how ridiculous the underwriters can make themselves in this city, where it is claimed that the best wiring in the country is done.

It is greatly to the credit of the illuminating company who contracted for the wiring of the building that they refused to countenance this work, and the writer thinks he is safe in stating that they have informed the underwriters that they (the illuminating company) could not consistently accept the work, even though it was passed and sanctioned by the underwriters. The work in question is not only a violation of the latest rules of the underwriters, but even if it were not in violation of the underwriters' rules, it is most assuredly a *make-shift* piece of work from an electrical standpoint. But, of course, those who have had experience with the underwriters know that the question of good mechanical or electrical work does not appear very often in the rulings of the underwriters, they simply passing upon what they consider hazardous or non-hazardous; therefore the writer is perhaps going too far to criticise the work from an electrical standpoint.

I think that the editorial as above referred to, is a step in the right direction, and all the electrical papers in this city, or in fact throughout the country, should take up in an intelligent and consistent manner for criticism, the *actions* of the various underwriters associations, and not their *rules*. For instance, the International Underwriters' Electric Association, at the last meeting, recommended the adoption for all underwriters associations of a set of rules and requested that the various associations should adopt these rules and enforce them. I think the writer is safe in saying that all the associations have adopted them, but as to whether or not they are enforcing the rules, and as to their methods of attempting to enforce the rules there arises a grave doubt.

A great many illuminating companies and contractors know to their embarrassment that the solution of standard rules has not yet reached such a state that any two inspectors of any board or any two boards of underwriters will uniformly agree upon different classes of work, even if said work is in the same class of buildings, and performed in the same general manner. To illustrate, if you read the rules and requirements as adopted by the various boards, and recommended by the International Underwriters' Electric Association, you can hardly fail to note that the word *approved* repeatedly appears, and this one word in a great many cases renders the entire set of rules of practically no value, inasmuch as every inspector has the liberty, and most emphatically assumes the liberty, of stating what in his opinion is meant by the word *approved*. And right here in this city this very word has caused considerable annoyance, and in fact loss of money to contractors and others, owing to the fact that no two inspectors seem to agree as to what is and what is not *approved*.

It seems to the writer that the Interior Conduit Company are fully justified in stating that the underwriters' rules are either good or bad, and if good they should be enforced, and if bad should be changed; but it is somewhat difficult to comprehend why a so-called "National" set of rules, intended to be standard in their character, should be sent out so worded that inspectors may place their own conclusions upon the rules to such an extent that illuminating companies and contractors cannot and do not know what is desired until the work is complete, and then they are calmly informed that such and such appliance, and such and such work is not *approved*, and when they ask, Why not? they are told,—Because it is not. That is the usual strength of all arguments of certain inspectors.

To cite a case showing the absolute inconsistency and dogmatism of an inspector, and to show to what extent he can subject contracting parties to annoyance, would be to mention a case of an installation recently placed in the interior of New York State, where the work was laid out and executed by a party who stands second to none for ability and integrity on electric light work, and whose name, if mentioned, would be a full guarantee that the writer's remarks are absolutely true. After having completed his work the contracting engineer was informed that the party who did the work, under his supervision, had not done the work properly, inasmuch as a certain class of moulding and certain appliances had been used, and although no argument was advanced to show any hazard placed upon the building, the work had to be entirely re-constructed, owing to the fact that the word *approved* appeared throughout the inspector's rules, and consequently he was clothed with authority to compel the contracting engineer to either do the work over, or else it would be condemned and he would receive no compensation for what he had honestly and conscientiously placed in position in accordance with the rules, as submitted to him. And furthermore, it might be interesting to note that up to date although repeated applications have been made to the underwriters having authority over this district, the unfortunate contractor has not yet had his work re-inspected or *approved*.

The writer's experience has been a very wide one with the insurance interest and with various departments, and he knows whereof he speaks when he states that no two inspectors throughout the entire country can be found to agree as to what is and is not an approved appliance or method of wiring, as it would seem to be indicated by the so-called standard rules adopted by the underwriters' associations.

The Interior Conduit people deserve thanks for having taken the first step in the way of ascertaining, if possible, "What rules are made for," but if they keep on investigating they will find that rules are made for unknown reasons. Nine times out of ten they are made through ignorance of the subject which they are supposed to embrace, and to clothe with absolute authority certain parties, and allow them to show their lack of knowledge of the science or the art of interior electric lighting.

E. O. W.

NEW YORK CITY, MARCH 8, 1894.

IRON PIPES FOR INTERIOR CONDUITS.

AT the recent convention held in Washington, the writer was afforded considerable pleasure in noting that the Interior Conduit Company have at last recognized the value of iron conduit. As is known to a good many of your readers, the writer has for the past five years striven to have iron conduit recognized, and in June 1892, you kindly presented an article which gave expression to his views. Mr. E. H. Johnson, President of the Interior Conduit Company, in the following issue made rather a sarcastic reply against the use of iron pipe for interior work, and hence the writer is more than pleased to note that he has recognized his mistake; but I would invite his attention to the fact that he has not yet arrived at the desired point.

The present pipe system as introduced by him is exceedingly cumbersome and awkward, to say the least, and bringing it out as he does now, soon after the underwriters have issued rules prohibiting the use of twin wires in any conduit, he will learn that iron pipe cannot now be used on alternating circuits, owing to the well-known large loss due to inductive effects. If Mr. Johnson had recognized his mistake sooner, and brought out his iron pipe system at the time twin wires were allowed, and insisted upon placing the insulation, where the writer has always insisted it always should be placed,—upon the conductors themselves,—he would not be in the embarrassing position of putting upon the market an article which the alternating people cannot use. It is also worthy of notice that his pipe system, as he now contemplates using it, gives a very large outside diameter over a very small inside diameter, which will tend to make it prohibitive in a great many cases.

The system that will finally be brought out, as the writer stated in 1892, must take its lesson from our friends, the enemy, the gas people, and a plain iron pipe system treated in a proper manner will be the ideal system. As is now well-known, the use of plain iron pipe for interior work at the World's Fair proved eminently successful, and it is to be hoped that the Interior Conduit people will continue to follow out the line of improvement, which they have been pursuing for the past four years. The writer fully appreciates the fact that it is due to the Interior Conduit Company, through the efforts of their President, Mr. E. H. Johnson, that we now have the present well-known and convenient method of conduit wiring, and fully realizes that it is owing to the efforts of Mr. Johnson that we have any conduit system at all; for, as a great many of us know, when he first started out with this conduit he met opposition from all sides. But, as is usually the case with Mr. Johnson, the more opposition he meets the more he is determined to win success, and the writer for one congratulates the Interior Conduit people upon the success which they have achieved in the past year, as it is now almost universally recognized to be a fact that for the very best work an absolute conduit system should be used; and it is to be hoped that Mr. Johnson will as quickly recognize the fact that his new pipe system is not all that it should be, just as he recognized the fact that his unarmored conduit was not what it should be, and very quickly gave us an article far superior, and now is improving on that conduit by introducing the iron pipe. The writer does not think it will be long before Mr. Johnson will be upon the market with an article superior to the one he is now using.

FREMONT WILSON.

NEW YORK, March 10, 1894.

THE ONE-VOLTMETER METHOD OF SWITCHING DYNAMOS IN PARALLEL.

In your issue of February 21st I find a description of Brenner's one voltmeter method of switching dynamos in parallel. The method is practically the same as one devised by me six years ago and used on plants installed by the Mather Electric Co. The only differences between my plan and Mr. Brenner's were first, the use of a special cheap instrument in place of the voltmeter, because the voltmeters used at that time by the Mather Co. with incandescent plants began to read at about 90 volts; and, second, the use of a *double pole* multiple point switch for throwing the dynamos to line through the instrument, because the main dynamo switch was double pole and, therefore, both poles of the dynamos were disconnected from the line until it was switched into circuit.

One pole of the multiple point switch connected one terminal of the dynamos to line through a resistance—usually a lamp—and the other pole connected the other terminal of the dynamo to line through the instrument. As the instrument was only used to show when a dynamo was at the same voltage as the line, and since this was indicated by the pointer coming to its position of equilibrium, there was no need that the scale divisions should have any definite value. The instruments were, therefore, not calibrated, but furnished with an arbitrary scale. It was only necessary that they should be sufficiently sensitive.

WM. A. ANTHONY.

VINELAND, N. J., Feb. 24 1894.

AIR-CORE TRANSFORMERS.

In a paper on "The Behavior of an Air-Core Transformer when the Frequency is Below a Certain Critical Value," read before the London Physical Society, Oct. 27, 1893, Mr. E. C. Rimington has called attention to the case in which the primary current of a transformer falls off when the secondary is closed. This phenomenon was noted by us last Spring and attention called to it in the *Electrical World*, June 17, 1893, in Article V., on the "Theory of the Transformer," where a curve is drawn (Figure 14) showing the value of the primary current for different loads. We have not yet seen the full text of Mr. Rimington's paper, but from various references to it would infer that much of the same ground has been covered by him as was given by us in a paper before the Electrical Congress in Chicago last August, entitled "General Discussion of the Current Flow in two Mutually Related Circuits Containing Capacity," printed in full in the *Physical Review* for Sept.-Oct., 1893. In a more recent communication, Mr. Rimington calls attention to the fact that Mr. Kennelly, in an article entitled "The Impedance of Mutually Inductive Circuits" in the *Electrical World* for Oct. 21, covered some of the same ground as given by him in his paper before the Physical Society above referred to. In a geometrical treatment of the same subject, "Theory of the Transformer;—VIII.," *Electrical World*, Nov. 25, we showed the identity between analytical and graphic methods of solution, including that of Mr. Kennelly, and showed that the whole is derivable from the results given in the paper above referred to presented by us before the Electrical Congress.

This decrease in the primary current of the transformer as the load increases, where the constants of the transformer have certain particular values, is certainly an interesting one although the amount of increase would always be small. Although the transformer has been the subject of a great deal of discussion, and its theory has been approached from all sides, and the instrument experimented upon by many different methods, it is still a fruitful source of study to the theorist and experimenter and there is still room for the discovery of many facts interesting and unique.

FREDERICK BEDELL.
ALBERT C. CREHORE.

CORNELL UNIVERSITY, ITHACA, N. Y.

SOCIETY AND CLUB NOTES.

NEW YORK ELECTRICAL SOCIETY.—THE ELECTRIC LIGHTING OF THE WORLD'S FAIR.

The New York Electrical Society continues with steady persistence and success its good work of popularizing electricity, and not a meeting now occurs at which some excellent paper is not presented. Its accession of new members is also large, the list being enlarged in a remarkable manner from social and professional circles in which are a great many intelligent people who seek information on electrical subjects. At the meeting at Columbia College on March 15, ten new members were elected, including a clergyman and two or three doctors, one of them a lady, and a very interesting lecture was delivered on "The Electric Lighting of the World's Fair."

The hall was crowded to a degree, in spite of the wretched weather, and the audience was most appreciative. The lecturer of the evening was Mr. T. C. Martin, who stated that he had had the active co-operation and assistance of Mr. Luther Stieringer, the consulting electrical engineer of the Fair, with whom he had been collecting illustrative material for some time, especially with the object of illustrating night effects with electric illumination. They had collected such photographs, etc., on all sides, some of the most successful being those of Mr. Oscar H. Baldwin, who had charge of the fine Westinghouse exhibit at the Fair, and who had used non-halation plates. The lecture was illustrated by about a hundred slides, of which a large number were of night effects and scenery.

Mr. Martin recapitulated the main statistics of the magnitude of the Fair and its lighting, and contrasted them with those of New Orleans, Paris, and other exhibitions. He went on to describe and depict the boiler plant, power plant, subways, etc., and then took up the various buildings, paying special attention to Electricity with its Tower of Light and Scenic Theatre. Then came Horticultural, Fine Arts and Liberal Arts, the latter with its great interior coronas and its four exterior search lights. Then a run was taken over to the Midway, with night and day views of the Ferris Wheel, after which the circuit was made of the Woman's Building, Fisheries, Transportation, Mining, Agricultural; and thus to the Administration Building. In each case, the individual and distinctive features of the lighting were described and quite freely illustrated. The Administration Building inside and out was very neatly handled, and then the Court of Honor was brought slowly into range by a fine series of views by night and day, with some of the effects of the search light. After looking at the Court from the Lagoons, the Peristyle and the Colonnade, Mr. Martin discussed the illumination of the Court, pointing out its beauties and also the way in which it could have been enhanced in spectacular effect.

Attention was now concentrated on the Stieringer electric fountains which were not only treated by the lecturer in a very poetical manner, much to the pleasure of the audience, but were, so to speak, taken apart, so that everybody could understand their mechanism and method of operation. Mr. Martin emphasized their value as a new and beautiful amusement for city populations where ground was available for their display. The pumping station, the signaling tower and the inside of the fountains were all shown in detail, and then came a wonderful series of night views of the fountains in play. These literally brought down the house. Then came a beautiful finale with the Court under night aspects by electric light; next in contrast was a moonlight view of the same scene, and the good night was a superb slide from a photograph, taken on the last night, of the search lights, when pointed at the Administration Building, and when "with overarching swords of white flame they encrowned it and paid it the parting salutation of electricity's homage."

A fine lantern was loaned for the occasion by J. B. Colt & Co., and was operated by Mr. Hopkins of that house, a member of the society.

CALIFORNIA ELECTRICAL SOCIETY.

At the recent annual meeting of this Society, Mr. G. P. Low, was elected president for the third time; C. O. Poole, vice-president; Max Caspari, secretary; H. T. Bestor, treasurer; and E. O. Roe, J. Fink and Orion Brooks, executive committee.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The 85th meeting of the Institute, will be held at Headquarters, 12 West 31st street, New York City, on Wednesday, March 21st, at 8 p. m.

A paper will be presented by Prof. Wm. A. Anthony, of Vineland, N. J., Past President, "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp."

The discussion will be opened by Prof. W. Lispenard Robb, of Hartford, Conn

For the convenience of Western members, and in accordance with recent action taken by the Institute, a meeting of members residing in Chicago and vicinity, will be held on the same date and hour at the Armour Institute, corner 33d St. and Armour Ave. Chicago, Prof. D. C. Jackson of Madison, Wis., has been invited to present the paper of Prof. Anthony at Chicago, and Prof. B. F. Thomas, of Columbus, Ohio, to open the discussion.

LEGAL NOTES.

THE PERKINS SNAP SWITCH PATENT NOT CONTROLLING.—SCHUYLER ELEC. CO. vs. ELEC. ENG. & SUPPLY CO., OF SYRACUSE, N. Y.

UNITED STATES CIRCUIT COURT, Northern District of New York. *Final Hearing in Equity.* C. L. Buckingham, for the Complainant. Alfred Wilkinson, for the defendant.

COXE, J. This is an infringement suit based upon letters patent, No. 247,103, granted September 13, 1881, to Charles G. Perkins for a circuit-breaker for electric lamps.

The inventor says:

> "My invention relates to improvements in that class of switches for incandescent electric lamps in which the break is effected by the snap or instantaneous reaction of a spring when released from contact with a conducting point or plate; and it consists in mechanical details for effecting this, the principal features of which are a ratchet-wheel having both conducting and insulating teeth combined in operative relation with a spring pawl or detent, which acts as a contact-maker with the conducting portions of the ratchet, and by engagement with the insulating-teeth prevents the ratchet from being turned backward when the pawl has been released from contact with the said metallic portions."

After describing the mechanism as shown in the drawings he proceeds:

> "The principal advantages secured by the constructions above described are, first, that the circuit cannot be completed by turning the key backward, so that when the circuit is broken it must be accomplished by an instantaneous snap or reaction of the spring-pawl as it leaves the conducting portion of the ratchet; secondly, that the contact-spring cannot be injured by the attempts of incautious persons to turn the key backward, as might be the case with the lamps now in use; thirdly, good conducting metals which do not possess the requisite resistance for contact-springs may be employed with a spiral spring of steel or similar metal; and, finally, the arrangement of the parts is compact and durable."

The first claim only is involved. It is as follows:

> "1. The combination, in an electric-light switch, of a ratchet having metallic projections and insulating-teeth in the intervals between the same and a pawl or detent for engaging with the insulating-teeth when released from contact with the metallic projections, as and for the purpose specified."

It will not be pretended that the invention is a fundamental one. If there was nothing else in the case the language just quoted would preclude such an idea. The inventor concedes that his invention consists only in mechanical details for effecting improvements in circuit-breakers.

The device of the patent is an ingenious little contrivance for opening and closing an incandescent electric lamp circuit. It is shown as located in a lamp socket. Such an invention in any other art would probably be entitled to little consideration, but when the courts have to deal with patents relating to electricity they are apt to regard with superstitious awe the smallest contrivance by which that mysterious force is harnessed and set to work. Although this view of the subject may be correct in many instances it is thought that it is hardly applicable to the case at bar.

Snap action circuit-breakers used in connection with alternating insulating and conducting material were old. So were switches having a wiping contact and a turn in one direction only. This being so it certainly did not require a profound knowledge of electrical science to produce the patented structure.

In 1871 Gilliland obtained a patent for certain improvements in dial telegraphs in which he describes a disk having marginal notches and intermediate smooth portions which serve, in connection with a spring conductor, alternately to make and break the circuit. When the spring snaps off from a conducting tooth it rests in an insulating notch and the circuit is broken. Backward movement is prevented by a pawl bearing against a collar. The mechanical construction is, of course, different, but the principle is the same as in the Perkins patent.

The patents to Guest, Rogers and Floyd show different means of accomplishing the same result, viz., the quick making and breaking of an electric circuit.

It is perfectly clear, therefore, that the Perkins patent does not cover all snap action circuit-breakers and that it is confined both by the prior art and its own language to the device described. At least it is clear that it cannot be expanded to cover devices differing in size, shape, material, situation, mode of operation and object to be attained; devices whose only points of resemblance are features open alike to defendant and complainant.

The defendant's switches are made under letters patent No. 436,122, granted September 9, 1890, to Howard H. Crowell. They are snap switches it is true and they cannot be turned backwards, but in other respects they are much nearer several structures found in the prior art than to the Perkins switch. They are mounted on a large stationary china base, three inches in diameter and are intended to be screwed on a wall or other support. They cannot be used in a lamp socket.

Neither of the defendant's switches has a ratchet wheel and No. 2 has no insulating teeth or any equivalent therefor. Neither has a pawl or detent, unless a very broad construction is given to these words. Both belong to a different type of switch from the patented switch.

The court cannot avoid the conclusion that it would be doing injustice to the defendant and others to give the Perkins patent a construction so broad as to suppress improvements like those embodied in the Crowell switches.

The bill is dismissed.

EDISON ELECTRIC LIGHT CO. vs. THE UNIVERSAL ELECTRIC CO.—MOTION TO DISSOLVE INJUNCTION DENIED.

By a decision rendered Tuesday, March 13, Judge Ricks of Cleveland Ohio, denied the motion of the Universal Electric Company to dissolve the existing injunction obtained against it by the Edison Electric Light Company, restraining the Universal Company from infringing the Edison Lamp patent. The Universal Company moved to dissolve the injunction on the grounds that by reason of a certificate attached to the Edison lamp patent in 1883, which referred to certain foreign patents for the same invention, that patent expired with the English patent last November, or, at any rate, that the Edison Company was estopped from contending that it did not then expire. Judge Ricks denied the motion of the Universal Company on both grounds and the injunction against that company thus continues in force.

Referring to its opinion in the Buckeye case in which an injunction was dissolved as against that Company, the court says:

> The Court, in the Buckeye case, found that the defendant acted in good faith and relied on the acts and conduct of the complainants in limiting the Edison patents, and that its investments were increased in good faith, relying upon that act, and that all of them were made by it, before the revocation of March, 1893, and that the defendant was therefore not affected by said revocation.
>
> In the Buckeye Case, while the Court declined to say just what rights the public acquired as against the owner and assignee of the Edison patent by virtue of the voluntary limitation put upon its life by the Patent Office proceedings of December, 1883, it did find that the Buckeye Company acquired rights by virtue of the complainant's conduct and acts in connection with such proceedings, and that as to the Buckeye Company, the attempted revocation of March, 1883, was of no effect, because the Buckeye Company had made all its investments and business arrangements prior to such revocation, and thereby acquired vested rights which could not be disturbed. But in the case now under consideration, the defendants, unfortunately for them, occupy no such favorable attitude. They began business as an infringer, and of their two additional investments (if two were made), the last was certainly made after the revocation of March, 1893. They were bound to take notice of these proceedings in the Patent Office, and as to parties who had not acted in good faith upon the limitation of the patent made by the proceedings of December, 1883, and had not acquired vested rights before the revocation thereof, said revocation was certainly effective.

POLYPHASE LITIGATION.

The Westinghouse Co. is suing the General Electric Co., for infringement of the Tesla patents, the specific instance being the three phase plant at Redlands, Cal.

LITERATURE.

Street Railway Motors: with Descriptions and Cost of Plants and Operation of the Various Systems in Use or Proposed, for Motive Power on Street Railways. By **Herman Haupt**, C. E. Philadelphia, Henry Carey Baird & Co., 1893. 12°, pp. xv. + 213.

This work has been prepared by a well-known civil engineer of eminence in his profession, who for more than a generation has been a careful and painstaking student of the technical and economical aspects of the transportation problem in the United States. It is not an elaborate mathematical treatise, requiring for its comprehension a high degree of technical knowledge, but as the author states, "a simple statement of principles and their applications that will be readily comprehended by persons of limited scientific attainments; a treatise for the use and information of investors and of the public." A discussion of principles and practice having to do with street-railway motors, from the pen of so excellent an authority, could scarcely fail to embody much information of interest and value to those interested in that branch of industry. The different agencies considered by the author embrace animal power, steam-locomotives, electric systems, cables, compressed-air, ammonia, naphtha, hot-water and carbonic-acid motors. The points chiefly attended to are the comparative first cost, cost of operation and practical convenience of the respective systems. We think electricians will be not a little surprised at the remarkably good showing made by the compressed-air motor. If the figures and conclusions of General Haupt are entitled to credit, and it must be said that there appears no reason to question either their fairness or their accuracy, the electric motor is destined, at no distant day, to encounter a dangerous rival in a somewhat unexpected direction. The pneumatic motor is no novelty; in fact it underwent a pretty thorough trial years ago, both as a street-car motor and as applied to elevated railway service, and with results which seem to have been, from a technical point of view, in the highest degree satisfactory. The inventor of the particular system which was experimentally tested, who appears to have been a most accomplished mechanical engineer, appears to have unfortunately fallen into the hands of a coterie of professional "promotors," who were much more anxious to unload watered stock on the investing public at a high price, than to develop the commercial possibilities of the invention; the patents became tied up in litigation, and ultimately everything was brought to a hopeless standstill.

General Haupt has obviously taken great pains to secure the most trustworthy statistics obtainable, both as to the cost of construction and operation of each of the different systems; a matter of no small difficulty. The total expenses for horse-service appear to average, taking the street railways of the country through, about 24 cents per car mile. A careful discussion of the available statistics of traction by steam-motors, shows the cost to figure out about 21 to 22 cents per car mile,—obviously a saving which is quite insufficient to counterbalance the numerous objections to the use of these motors in public streets. The discussion of the naphtha motor is quite full, and the general conclusion is that under some conditions it promises to be of value in the future. It has not as yet been in practical use to a sufficient extent to deduce figures of cost that can be accepted with entire confidence.

The pneumatic motor, which is evidently a favorite one of the author, is dwelt upon at considerable length, and the data and conclusions given in relation to it are of great interest. It appears that in 1878 and 1879, five pneumatic motor-cars were run for several months on the Second-avenue line in New York. Reservoirs under the seats and platforms of the cars were found to be capable of storing no less than 17,000,000 foot-pounds of work, an amount capable of propelling the car some 16 miles on a level. The effect of the compressed air was found to be greatly increased —in fact nearly doubled—by passing it though a small tank containing five cubic feet of hot water, placed on one side of the platform. A duty of nearly 50 per cent. of the horse-power at the station employed to compress the air was secured from the utilization of the compressed air in the car-motor. By the employment of the best type of modern stationary engines, General Haupt computes that a given quantity of fuel will produce at least four times as much power as can be obtained from small independent steam motors. In descending grades, the working cylinders may be made not only act as brakes, but as pumps, and thus serve to replenish the pressure in the reservoirs. A careful estimate based on the experience of the Second-avenue line, shows a total cost of operation per car mile of only 13.42 cents, 7 mills of which was chargeable to fuel. In 1880, a motor weighing 18¾ tons was tried on the Second-avenue elevated line. It was found to be capable of hauling a five-car train over the road, making the usual stops, and performing in all respects the regular service, with an expenditure of 12,600 cubic feet of air, at atmospheric pressure. The consumption of fuel was found to be less than 20 lbs. per train-mile, less than half the amount consumed by the ordinary steam locomotives, and at not more than one-fourth the cost, as a much cheaper grade of fuel may be used in the stationary engine plant. Besides this, the wages of firemen on the engines are dispensed with, another large item of economy.

General Haupt presents itemized estimates of the comparative results attainable in the equipment and operation of a six-mile double track line, running cars at two minute intervals, which foot up as follows:—

	Cost of plant.	Cost of operation per car-mile.
Horse-power..............	$689,076	25 cents.
Steam-motors.............	767,076	23.81 "
Pneumatic motor....... ..	717,576	15.21 "
Cable......................	1,141,000	17.19 "
Electric....................	831,176	16.41 "

It should be stated that all these estimates include interest on original cost of plant. The figures for the ammonia, naphtha and hot-water motors have not been worked out in so much detail as those above given.

This is a work that every street-railway manager may study with profit. If nothing more, it proves to the electrical engineer the necessity of paying particular attention to the economics of electric transportation, else he may wake up some day not far distant to find in the pneumatic motor a formidable competitor in some of his most profitable fields of labor.

F. L. P.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 6, 1894.

Alarms and Signals :—

System for Signaling and Communication, T. F. Gaynor, Louisville, Ky., 515,761. Filed Dec. 30, 1891.

A police signal and telephone system by means of which the movements of patrolmen may be directed from headquarters.

Electric Signal Box, T. F. Gaynor, Louisville, Ky., 515,762. Filed Feb. 4, 1892.

Especially adapted to police signal systems.

Water Alarm for Boilers, C. A. Hatch, Hartford, Conn., 515,827. Filed Mch. 23, 1893.

Electric Circuit Breaker, D. S. Schureman, Rockford, Ill., 516,025. Filed July 19, 1893.

Relates especially to circuit breakers employed in connection with electric bells by means of which the bell will continue to ring a certain length of time after the circuit has been broken.

Conductors, Conduits and Insulators :—

Electric Cable, T. J. Dewees, Palmyra, N. J., 515,823. Filed Dec. 15, 1893.

Claim 2 follows :

An electric conductor or cable having a fibrous insulation from which the moisture has been expelled, powdered with a moisture absorbing medium such as powdered lime, and a closed sheath or covering hermetically sealing the fibrous insulation in its dried and powdered condition.

Splice Covering for Electric Wires, T. J. Dewees, Palmyra, N. J., 515,905. Filed July 25, 1891.

A sheath consisting of a tube of paper adapted to be slipped over the splice.

Electric Cable Joint, T. C. Loe, New York, 516,161. Filed Aug. 14, 1893.

Consists of a sleeve of flexible material extending outside the joint and having a wipe of solder about the inner end of the sleeve and joint.

Distribution :—

Electric Lighting System, H. J. Wells, Osceola Mills, Pa., 515,806. Filed Aug. 20, 1892.

Provides for grouping the terminals of separate and independent circuits so that a single current may be utilized to its fullest capacity and diverted rapidly from one circuit to another.

Electrical Transmission of Power, C. F. Scott, Pittsburgh, Pa., 515,885. Filed Mch. 27, 1893.

Claim 1 follows :

A main generator, a motor generator driven thereby, and a circuit fed by the latter ; in combination with a supplementary generator the field magnet strength of which is controlled by the current from the motor generator, and the electromotive force of which is added to that of the main generator.

Dynamos and Motors :—

Electric Motor, G. S. Dunn, New York, 515,755. Filed July 29, 1893.

Claim 6 follows :

An electric dynamo or motor having a field magnet so mounted on an axis in the base of the machine that it can approach and recede from the armature, and a brake for the armature controlled by such movements of the field magnets.

Dynamo Electric Machine, J. E. Maynadier, Taunton, Mass., 515,882. Filed Aug. 30, 1893.

Claim 1 follows :

In combination a plurality of shafts and a plurality of ring conductors connected electrically in series by connecting one edge of one ring conductor with a second ring conductor on the same shaft, and the other edge with a third ring conductor on another shaft.

Alternating Current Motor, C. E. L. Brown, Baden, Switzerland, No. 515,900. Filed June 18, 1893.

A non-synchronous alternating current motor whose induced winding is provided with a connection and corresponding brushes, connected and adjusted to produce poles in the induced winding, the position and action of which produce a turning moment to start the motor, and means for producing the short circuiting of the induced winding after the motor has attained its normal speed.

Alternating Current Motors, J. F. Kelly, Pittsfield, Mass., 515,962. Filed March 27, 1893.

The method of operating motors having independent fields and rigidly connected armatures which consists in energizing the field simultaneously by alternating current of the same phase, and energizing the armatures by alternating current of different value.

Alternate Current Motor, W. Stanley, Jr., J. F. Kelley and C. C. Chesney, Pittsfield, Mass., 515,977. Filed Apl. 1, 1893.

The method of operation consists in angularly displacing one of the elements of one part of the motor with respect to the corresponding element of the other until the motor has been brought to speed, and then bringing the element into alignment.

Armature for Dynamo Electric Machines, M. Waddell and J. B. Entz, Bridgeport, Conn., 516,170. Filed May 18, 1893.

Relates to certain mechanical details in the manufacture of ring armatures of the Waddell-Entz type.

Heating :—

Electric Heating Apparatus, A. E. Appleyard, Boston, Mass., 516,071. Filed Jan. 16, 1893.

Claim 1 follows:

An electric resistance, comprising a core externally coated with an insulating material, and provided with a continuous, seamless electrically-deposited, metallic shell covering the insulating coating and extending over the ends of the core.

Electric Radiator, S. B. Jenkins, Boston, Mass., 514,095. Filed March 29, 1893.

An electric radiator in which a heating conductor is wound on internal studs of the radiator casing.

Electrical Heater, A. Cochrane, Lowell, Mass., 516,152. Filed January 6, 1893.

Consists of a tube open at both ends and covered with asbestos, a helix of German silver wire, a perforated tube, enclosing the helix but leaving a space between the two tubes and annular rings at the ends for holding the tubes in position.

Apparatus for Generating Steam by Electricity, H. E. Rider and J. H. Lewis, New York, 516,167. Filed Feb. 17, 1893.

Lamps and Appurtenances :—

Electric Arc Lamp, J. J. Wood, Fort Wayne, Ind., 515,850. Filed June 7, 1893.

Employs circuit closing contacts in the shunt circuit mounted respectively on the armature and the armature lever and arranged to be normally separated when the magnets are inert, and to be closed by the initial movement of the armature under the attraction of the main magnet.

Automatic Cut-out for Incandescent Lamps, E. H. Johnson, New York, 515,960. Filed May 17, 1886.

Employs the soldering action of an electric arc induced between wires upon the breaking of a lamp, to cut the latter out of circuit and substitute a new lamp or an equivalent resistance.

Regulating Socket for Electrical Apparatus, E. E. Ries, Baltimore, Md., 515,969. Filed Jan. 24, 1893.

Employs a reaction coil and a holder composed of two blocks of refractory insulating material clamped together and to the reaction coil by the shell of the socket.

Electric Current Regulator, E. E. Ries, Baltimore, Md., 515,970. Filed Feb 2, 1893.

Claim 1 follows :—

A rheostat consisting of a carbon helix having convolutions of gradually increasing thickness, and means for compressing the helix and thereby short-circuiting the convolutions upon each other by insensible degrees.

Portable Regulator for Electric Currents, E. E. Ries, Baltimore, Md., 515,971. Filed Apl. 4, 1893.

Claim 1 follows :—

A portable current regulator, comprising means for graduating the flow of current, a plug adapted to incandescent lamp sockets, and a socket adapted to receive incandescent lamp bases or plugs.

Metal Working :—

Electric Metal Working, H. Lemp, Lynn, Mass., and W. S. Moody, Chelsea, Mass., 515,778. Filed May 26, 1891.

The invention consists in including the two pieces to be welded in a circuit between the terminals of a divided source of electric energy and connecting the work between the terminals with an intermediate point of the divided source and adjusting the relative potential of the two sides according to the conductivity of the pieces to be joined.

Miscellaneous :—

Process of and Apparatus for Purifying Sulphate Lyes, C. Von Grabowski, Eisleben, Germany, 515,763. Filed July 15, 1893.

Railways and Appliances :—

Electric Switch Signal, T. L. and N. W. Dalton, Sandy Hill, N. Y., 515,751. Filed Aug. 5, 1893.

A combination of a signal circuit and a trolley circuit in which the signal is operated by bringing the signal wire into contact with the trolley wire.

Strain Insulator, H. H. Luscomb, Hartford, Conn., 515,779. Filed Nov. 4, 1893.

Consists of a pair of eyes having integral shanks bearing washers of laminated insulating material and enlarged heads integral with the shanks but insulated from each other and a sectional metallic drum surrounding the head and washers.

Hanger for Trolley Wires, G. Forbus, Williamsport, Pa., 515,907. Filed Sept. 6, 1893.

Comprises two separable members adapted to be secured together and hold the trolley wire between them, one of the members having perforations to receive the suspending wires.

Switches and Cut-Outs :—

Automatic Switch for Storage Battery Use, T. A. Willard, Norwalk, O., 516,038. Filed July 1, 1893.

Thermostat, E. Barney, Schenectady, N. Y., 516,043. Filed Sept. 20, 1893.

Telegraphs :—

Telegraph Repeater, W. E. Sloan, Chicago, Ill., 515,845. Filed July 14, 1893.

Employs two electro magnets each provided with two sets of coils both of which are in the main circuit when the latter is closed and only one of which is in circuit with the local battery when the main circuit is open.

Telephones and Apparatus :—

Telephone Receiver, C. Selden, Baltimore, Md., 515,797. Filed Dec. 10, 1889.

Employs two or more magnets having magnetically independent cores and operating in conjunction but in immediate succession to produce sound impulses.

Telephone Exchange System, E. Pope, Quebec, Can., 515,939. Filed Aug. 3, 1892.

A system entirely dispensing with the use of spring jacks and substituting therefor plain contact points in the circuit.

Telephone System, E. Pope, Quebec, Can., 515,940. Filed Sept. 2, 1892.

Has for its object a simplification of the exchange apparatus by doing away with the spring jacks and the large numbers of extensible terminals used in connection with the magneto system.

COAL HANDLING PLANT OF THE NEW YORK EDISON CO.

ONE of the most complete coal handling plants installed in an electric lighting station has lately been put in at the main station of the Edison Electric Illuminating Co. of New York, situated at the corner of Pearl and Elm Streets. The coal is dumped through the sidewalk into a hopper, which is supported on a scales, the scale beam being placed inside the building on a level with the sidewalk. Through a small window the operator is able to see when the coal is dumped, weigh it, and by pulling a lever, allow the coal to pass through to a conveyor, which takes it into the boot of an elevator, situated immediately inside the front wall of the building. This elevator is 128 feet high, and consists of a single strand of Dodge chain supporting a continuous line of automatic dumping steel buckets. The elevator is enclosed in a dust tight steel casing and runs up between the freight and passenger elevators to the sixth floor, where the coal is dumped into a short conveyor, placed at an incline, which carries it opposite the centre of an immense coal bin, which runs from the fifth to the sixth floor. From the end of the short conveyor a conveyor about 200 feet long runs down the entire length of the building, over the bin, and is so arranged that the coal can be dumped into the bin at any point. The return strand of this conveyor runs in the same horizontal plane as the carrying strand, so that the strands run by each other in opposite directions. Another elevator, which will also be 128 feet high, will be placed at the Duane street side of the building, and the coal can consequently be carried along in the same conveyor, in opposite directions, so that in case of accident to one elevator, the other can be run. The conveyor is of the noiseless suspended pattern, and the whole plant, which has been in successful operation for some months, was installed by the Link-Belt Engineering Co., of this city. The capacity of the above machinery is about forty tons per hour.

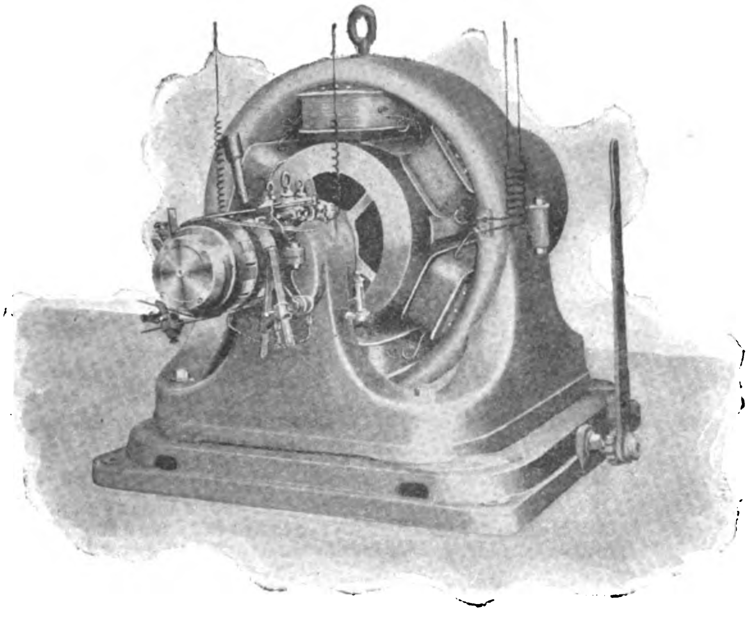
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE WESTINGHOUSE DIRECT CURRENT ARC GENERATOR.

THE Westinghouse Electric & Manufacturing Company have for a long time been carrying on a series of extended and elaborate experiments with a view to obtaining a machine which would better fulfill the requirements of direct current arc lighting than those heretofore in use. The results of these experiments they have embodied in their new direct current arc machine shown in the accompanying illustration. Though the new machine differs very radically in construction from former types, it belongs to the well-known open coil continuous current class, which is claimed to offer special advantages for arc lighting work. The machine in general appearance is similar to the Westinghouse standard alternating current dynamos; that is, it consists of a circular cast-iron yoke parted horizontally, and having inwardly projecting poles. The armature is of the toothed type with lathe wound coils, very heavily insulated. The armature is supported in self-oiling bearings with spherical seat, so that the machines are self-aligning. The bearings are cast solid with the lower half of the field, thereby securing great strength and rigidity of construction.

A particularly strong point about this machine is the system of regulation. It has absolutely no regulating devices or wall regulators. Regulation is effected as in alternating current arc machines, by the reactive effect between the winding of the field and the armature. The generator may, it is said, be short-circuited and run without injury, and is absolutely self-regulating throughout its entire range of load. The commutator is of a new type which presents a large bearing surface for the brushes and has the segments separated by half an inch of insulation, so that the machine is particularly free from sparking, and four sets of copper brushes collect the current without the use of "blow-outs" or other devices intended to avoid sparking. The field coils are connected in series with one another. The exciting current is supplied from a separate low voltage machine so that the use of high potentials in the field windings is avoided. The machine has an efficiency of over 90 per cent. and is rated at 9½ amperes.



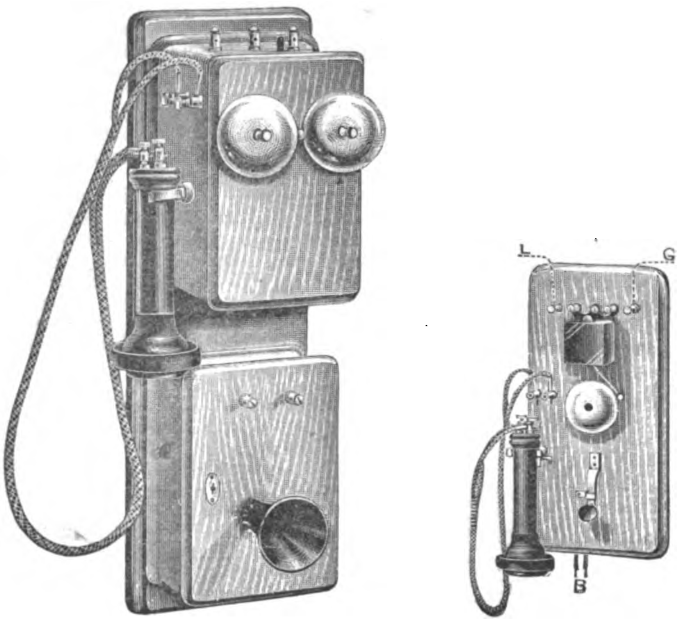
WESTINGHOUSE DIRECT CURRENT ARC GENERATOR.

AMONG recent shipments and orders of the Ball Engine Co., of Erie, Pa., are the following, made to public buildings in different parts of the country: Two 100 h. p. engines, to the Criminal Court Building, Chicago; one 100 h. p. engine, to the House of Correction, Chicago; one 60 h. p. engine, to the Illinois State Reformatory, Pontiac, Ill.; one 100 h. p. engine, to the Industrial Home for the Blind, Chicago; two 100 h. p. engines, to the State Asylum for Chronic Insane, Wernersville, Pa.; one 185 h. p. engine, to the Willard State Hospital, Willard, N. Y.

TELEPHONE OUTFITS OF THE MANHATTAN ELECTRICAL SUPPLY COMPANY.

THE METROPOLITAN ELECTRICAL SUPPLY COMPANY, of 86 Cortlandt street, New York City, have issued an interesting catalogue of their telephone receivers, outfits and line material, including instruments and material which make the most complete telephone sets that are free from infringement and sold outright at the present time.

Two of their newest instruments are shown in the accompanying illustrations. Fig. 1 represents the outfit considered the best by the company. The magneto call bell will ring on very long lines, and automatic switches are employed for which several patents have been applied for. In the top of the receiver is a movable conductor, so that when the instrument is not in an upright position the circuit is made through the coil of the receiver. When on the hook the circuits of the receiver and transmitter are broken, which not only reduces the resistance of the circuit where more than two instruments are used on a line, but also prevents the coils of the telephones from being burned-out from lightning when not in use. The switch on the magneto call bell keeps the circuit of the signaling apparatus closed when the telephone is not in use. It is necessary to raise the switch when placing the telephone on the hook; consequently it will be impossible for a careless person to leave the circuit open.



FIGS. 1 AND 2.—MANHATTAN TELEPHONE OUTFITS.

Fig. 2 shows the company's cheapest outfit. The signal furnished with this to attract attention at the distant station consists of an electric bell and several Mesco dry batteries. The hook is provided with a cut-out which reduces the resistance of the circuit so that the call bell will ring on a long line where a few batteries are used. A strap key is used to operate the call bell, and the receiver is also used as a transmitter. No battery box is attached to the back-board, but the batteries can be placed in any convenient place near the telephone.

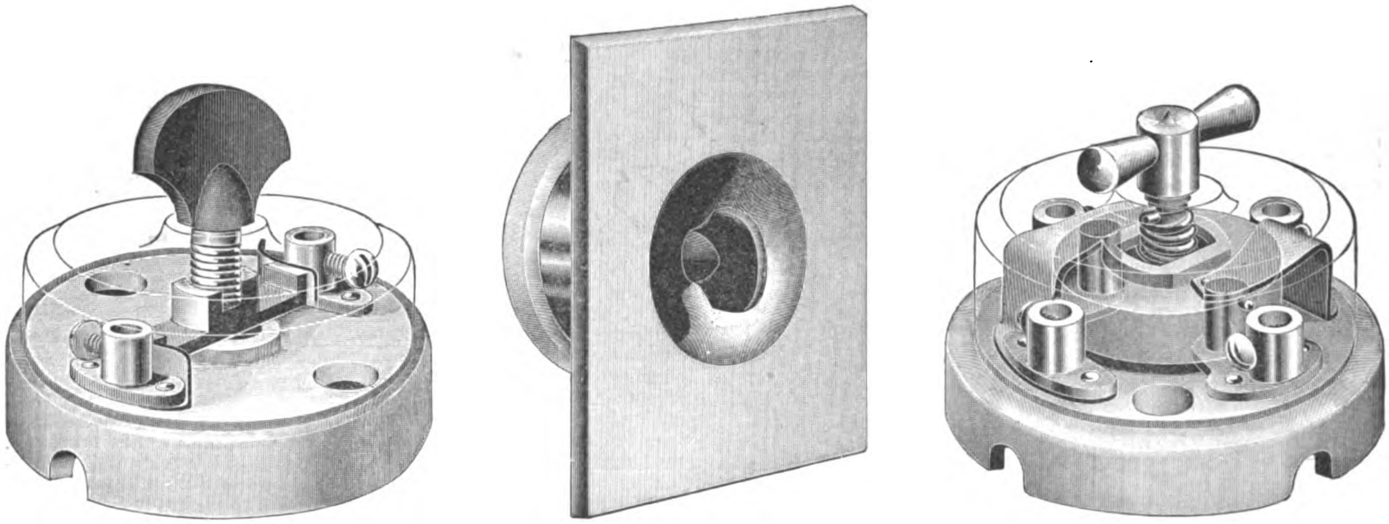
In addition to the telephonic apparatus the company manufacture a long list of electrical specialties, including annunciators, batteries, burglar alarms, medical apparatus, etc. Their factory is at 14 and 16 Morris street, Jersey City, N. J.

THE GREAT WESTERN MFG. CO., Chicago, through their light and power department have just closed a contract with Messrs. Fraser & Chalmers, Chicago, for an electric light plant to go to Mexico. This apparatus is to be transported over the mountains on mule back to mines, and one condition of the order was that no package is to weigh over 300 lbs. The Great Western Mfg. Co. make machines of any size to meet these conditions, their recent development in their apparatus allowing them to sectionalize any piece, so as to conform to the regulation weight mentioned above. The mining companies throughout the country, and especially in the American district of Mexico, are commencing to realize that the only economical and proper way to transmit power any considerable distance is by the use of electricity. The Great Western Co. are prepared to figure with any mining enterprise in regard to light or power installations and are ready to furnish suitable apparatus for plants of any magnitude.

THE GIBBS SWITCHES.

The accompanying engravings represent a few varieties of the Gibbs switch, which are quite new and novel in design, and which embrace many excellent features. Fig. 1 shows the regular Gibbs 220 volt double pole switch, which employs a principle in mechanics never before used in switch construction. The handle has a screw cut on its lower end, which fits into a nut loose in the insulating block, and which when turned, raises the nut, so as to free it from its lock in the base. The nut then causes the insulating block carrying the contact pins to revolve with great rapidity, for one quarter turn, when it again drops into its seat where it is firmly held, until the switch is again operated. The parts revolve in one direction only. The insulating block is fitted with two contact pins, passing entirely through the insulation and these are fitted loosely in their positions, so as to allow of automatic adjustment between the upper and lower spring copper brushes. When in contact the insulating block is free to move slightly in any direction, and cannot possibly bind the contact pins. All the parts are strong and not liable to give out, but to protect against any trouble, they are made absolutely interchangeable, and can be replaced in a moment should any breakage occur.

Fig. 2 represents the Gibbs flush switch for which there is a growing demand for residence and office installations, and these can be made to be operated only by keys so that no one except duly authorized persons can have access to them. These switches are fitted with a spring lock, which fastens the flush plate to the cast iron box so that no one unprovided with a specially designed key can either remove the plate to operate the switch, a provision peculiarly acceptable in insane asylums and other institutions. Another form of the Gibbs switch is designed for specially fine or ornamental work, the outside of which is made entirely of porcelain, and in which the cover screws to the base. The working parts are the same as in the other types of Gibbs switches, and plain white porcelain is usually furnished except when otherwise requested, when any desired decoration can be procured. Fig. 3 represents a very interesting switch, which has been specially designed for breaking 500 volt currents, and is therefore peculiarly adapted for railway and power circuits. It is extremely small, being only 2¼ inches in diameter, and the same mechanism is used as in the double pole switch, but by a different arrangement of the screw working device, a break of 1¼ inches is obtained, or more than one-third on each side, a result which has not previously been attained. This is a particularly desirable switch for railway work, being very neat, and suitable for car work, and fills a want that has been felt for a number of years. These switches are made as flush switches, single or double pole as may be required, and are being manufactured and introduced by the Perkins Electric and Manufacturing Co., of Hartford, Conn.



Figs. 1, 2 and 3.—Gibbs Switches.

IMPORTANT REMOVAL OF CENTRAL ELECTRIC CO.

The Central Electric Co., through their president, Mr. Geo. A. McKinlock, have just consummated a lease for the five story building, 173 & 175 Adams St., formerly occupied by the General Electric Co. and will move to this new location as soon as the premises can be put in convenient shape. The causes that led to this change can be easily imagined by any one who ever had the good fortune to become acquainted with this well-known and progressive supply house. They were simply driven to it by the ever increasing business coming to them from all parts of the country. The new building occupies a frontage of 50 feet on Adams street, is 175 feet in depth, and as already stated, is five stories high. While to a concern like the Central Electric Co. location in any particular part of the city is of secondary importance, their new home will certainly be more accessible to their friends and customers, especially to those who live out of the city.

As soon as the change is made, and everything is in place, all of the company's friends and acquaintances will be invited to a grand house warming, and we predict that a more congenial and well-taken-care-of crowd will not assemble again in this city for a long time to come.

THE HAYDEN-BOOKER MFG. CO.

Mr. M. M. Hayden well known through his six years' connection with the Law Telephone Co., and as manager of the Law Battery Co., has resigned as president and manager of the latter company to embark in a wider field, and has assumed the management of the Hayden-Booker Mfg. Co.

The Hayden-Booker Company are organized as manufacturers. They make their carbons, zincs, covers and jars, and as a consequence are satisfied with the first or manufacturers' profit. They also bring into the business an experience that is a guarantee of the excellence of their apparatus. Mr. Booker, as a carbon maker, and Mr. Hayden as a practical battery maker, have given the subject several years' close study, and are content to let their work praise them. The Hayden-Booker Mfg. Co. will manufacture the Hayden carbon porous cup No. 1 cell, the Hayden carbon porous cup No. 2 cell, a Leclanché clay porous cup cell, a standard Fuller cell, a No. 2 Fuller cell, a single cylinder carbon cell and a double cylinder carbon cell.

The company are located at 2140 DeKalb street, St. Louis, Mo.

NEW YORK NOTES.

Messrs. J. W. Parker & Co., agents for the Ball Engine Co., have moved their office from 18 to 30 Cortlandt St. where they will have much larger quarters to accommodate their fast growing business.

The Manhattan Electric Co. have leased the large store and basement at 32 Cortlandt St., which will be used in addition to their two upper floors they now occupy two doors below. They are compelled to make this move on occount of their rapidly increasing business and the change will be appreciated by their many customers.

PHILADELPHIA NOTES.

The Electric Storage Battery Co., of Philadelphia, whose display of chloride accumulators at the recent Convention attracted such favorable attention and comment, was represented on that occasion by Mr. J. Appleton, and not by Mr. Williams, as stated in our issue of March 7.

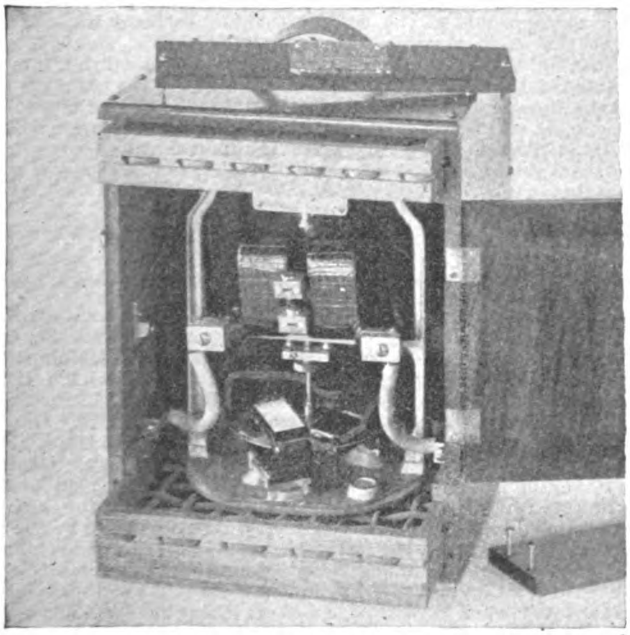
NEW ENGLAND NOTES.

The Mather Electric Company, of Manchester, Conn., have appointed S. N. Blake, of Elmira, N. Y, contractor for the Mather apparatus in northern and western New York state.

PORTABLE THOMSON RECORDING WATT METER FOR STREET CAR TESTING.

IT IS frequently necessary in electric street railway practice to test the power consumption of the cars, and heretofore the General Electric Company has furnished a voltmeter reading 500 volts mounted rigidly within a mahogany box for this purpose. This was, however, found not to be without faults. The mechanism being rigidly mounted, the meter was subjected to violent jars which frequently interfered with its accuracy, shortened its life and rendered it unsatisfactory. Experiments have been going on for some time past to evolve a satisfactory portable recording meter for the purpose named, and the General Electric Company now announces one which will satisfy the many requirements of street railway service.

The meter in question, illustrated in the accompanying engraving, consists of a Thomson recording meter mounted on a skeleton metal frame, and having a capacity of 25 amperes at 500 volts. It is mounted within a polished wood carrying case about two-thirds the size of the former type. Instead of being rigidly mounted in the case the meter is suspended between two networks of interlaced rubber cord, or, as it were, between two rubber hammocks. This method of suspension saves the meter from violent agitation or shocks, and renders its indications reliable. It is the first time that this system has been applied to a recording meter and it is a feature which will recommend it to street railway men. The meter may be used placed upon the floor of the car with absolute safety and convenience and gives perfectly accurate readings.



PORTABLE THOMSON RECORDING WATTMETER FOR STREET CAR TESTING.

The meter, is normally rated at 25 amperes. In testing street cars, however, the current will frequently, for short intervals very greatly exceed this, as when starting, or upon heavy grades; but this meter is so constructed as to record these sudden bursts of current accurately and enormous overloads may be carried through the meter for short intervals without detriment to the instrument or impairment of its accuracy. The meter has been subjected to careful and severe tests with very satisfactory results.

NEW YORK NOTES.

THE OKONITE CO., 13 Park Row, have issued a very dainty little desk clock, encased in glass, to their friends and customers. There could not be a better reminder of the fact that the good qualities of Okonite and its representatives are undisturbed by the flight of time.

THE ELSON & BREWSTER ENGINEERING CO., the New York representatives of the W. S. Hill Electric Co., of Boston, are obliged for the second time within a year to move into larger quarters, and they can now be found at 143 Liberty street, where, with better facilities and a larger stock, they will develop their business.

MR. JOHN R. MARKLE, who has done so much successful pioneer work in electrical development out West was in New York last week making arrangements, it is understood, for something new and promising. He reports that clouds in the West are rifting and that the outlook brightens.

MR. W. L. FAIRCHILD, electrical engineer, 521 Kirk Building, Syracuse, N. Y., has been appointed consulting engineer for the city of Jamestown, N. Y., which is spending $32,000 to improve and enlarge its electrical plant. Mr. Fairchild has also recently been appointed electrical engineer for D. McCarthy & Co., of Syracuse, who are building a block, and will install a very large isolated plant.

THE CENTRAL ELECTRIC HEATING CO., Havemeyer Building, New York, are using a very interesting letter from Mr. Geo. Jamme, the electrician of the whaleback steamer, "Christopher Columbus," in which he states that while that fine boat was running between Chicago and the World's Fair, they found no difficulty in cooking four meals a day for a crew of 75 persons. It was very economical and a coal range was utterly out of the question.

MR. A. J. CORCORAN, the windmill designer and constructor, has just put up the highest windmill tower in the world, for Mr. Prescott Hall Butler, at St. James, L. I. It stands 190 feet above high water, and is itself about 150 feet high. It fills a reservoir of 65,000 gallons capacity in two days easily. A mill built for Mr. E. H. Johnson's country seat by Mr. Corcoran raises water 600 feet. Mr. Corcoran reports business as very active and bright. He is greatly interested in the attempts to utilize wind power for electricity.

WESTINGHOUSE, CHURCH, KERR & CO., after ten years occupancy of 17 Cortlandt street, have removed to the Havemeyer Building, where they will undoubtedly increase and extend the reputation they have already won by their high class engineering work, and by their introduction of the Westinghouse engine, the "steam loop," "Kodak" plants, refrigeration and ice making apparatus, etc. They will be glad to enter into correspondence with local lighting companies and others as to ice making work. At the present time they have on hand no fewer than 20 orders for such equipments. Their new offices on the sixth floor of the Havemeyer comprise four large rooms en suite and a connecting hall.

WESTERN NOTES.

THE WALLACE ELECTRIC COMPANY, Chicago, have secured large and commodious quarters in the Manhattan Building, 307 Dearborn street, and will move on or before May 1st.

A PULLEY THAT SAYS NOTHING but does the work and does it well—that was George Cutter's aim in designing his new swivel pole pulley. Now he says that the orders are rolling in and showing the great value of such an article.

THE KNAPP ELECTRICAL WORKS, Chicago, report a noticeable increase in the number and size of orders for the "Safety" Seamless, Solid Rubber Insulated Wires and Cables. Business in all their departments show every indication of prosperity and returning good times.

MR. J. HOLT GATES, Western Manager for the Waddell-Entz Company, will in future represent also the Mather Electric Company, as Western Sales Agent for their belted railway generators and motors. The combination of two such well known types of electrical apparatus, should make it an easy matter for Mr. Gates to secure a large share of Western business in that line.

C. B. WOODRUFF & COMPANY, Chicago, Western agents for the A. C. L. Company are meeting with good success in the sale of "Canvasite" flexible tubing and "Canvasite" cord. They also show a new kind of double conductor Mining cord, made especially with a view of standing rough usage. The conductors in addition to the regular rubber insulation are protected by a rubber envelope which acts as a cushion, the whole being finally served with a woven Canvasite jacket. Messrs. Woodruff & Company have just received an order for a 60 inch 3 ply short lap leather belt for the De Kalb, Ill., Wire Works. This belt is one of the largest shipped out of Chicago for some time past.

HORNE & MARTIN, Chicago, General Selling Agents for the National Electric Company, have recently secured some nice orders for central station plants. Last week they were successful in closing a contract at Sandwich, Ill., in the face of extremely fierce competition. The plant will consist of a 1,200 light alternator, and in addition to the regular equipment of transformers will include 60 special converters of 80 volts, to be used in connection with 60 of the new Mosher "Hot Wire" arc lamps. They also report the sale of a 2,500 light alternator to the New Albany, Ind., Light and Power Company.

The Chicago Edison Co. have increased their capital stock from $3,000,000 to $5,000,000.

Mr. Asa A. Forman, Manager of the Iron Mountain (Mich.) Electric Light and Power Company, was in Chicago last week, contracting for coal and other supplies for his Company.

The Sunbeam Lamp Mfg. Co. Chicago, have moved from their former location at Randolph St. and Michigan Ave. to more commodious and convenient offices in the Association Building 153 La Salle St.

The Northern Electric Co. of Chicago, was incorporated March 3, its object being to "operate, construct and maintain horse, dummy and street railroads in the city of Chicago." Its capital stock is $50,000.

Mr. Wm. Hornberger, General Manager of the Hornberger Electric Manufacturing Co. of Elkhart, Ind., is very enthusiastic over the results of some careful tests recently made of their "Toothed Type" transformers.

Mr. W. C. McKinlock, secretary of the Metropolitan Electric Company reports business as being on the increase, having just returned from an extensive business trip, with some good sized orders for the specialties handled by his company.

Harrison & Carey, Chicago, are sending out their new catalogue of solid sheet mica insulators, etc. It is a neatly gotten up pamphlet, containing a very complete list of their well-known electric railway appliances. It will repay all interested to send for a copy.

The Washington Electric Co., Chicago, contemplate moving to more commodious quarters not far from their present location. They are meeting with good success in the sale of their alternating and direct current arc lamps and the Meissner "Imperial" rheostat.

The introduction of the Packard transformer has met with such a large success that the Electric Appliance Company as western selling agents have found it necessary, in order to meet the demands of their trade, to carry a large stock in their Chicago store. Several large shipments have already been received and more are on the way, and the company are now prepared to ship all ordinary orders from Chicago stock without delay.

The Mutual Electric Light & Power Company, Chicago, finally succeeded in having their ordinances passed at the last Council Meeting, and it is believed that it will receive the Mayor's signature. The ordinance gives the Company permission to "erect and maintain one or more systems of electrical conductors above or underground for the transmission of electric light, power and heat, or either of them." It also contains a provision expressly prohibiting the Company from furnishing power for any surface railway. One cent an hour for a 16 candle power light may be charged. For an arc light, $10 50 a month is the maximum charge for all night lamps and $7.50 if it be extinguished at midnight.

The Central Electric Company report a larger demand for the new iron armored interior conduit which has been brought out to meet the requirements of a higher grade of construction. Their first order was given by Mr. G. W. Furbeck, 1161 Monadnock Bldg., who will use it for the wiring of the new West Side tunnel, where the presence of a large amount of moisture renders the use of a high insulating medium imperative.

Pierce & Richardson is the style of the firm of Electrical Engineers, who on March 1, opened offices at Nos. 527 and 529 Manhattan Building, Chicago. Mr. R. H. Pierce, as Electrical Engineer of the World's Fair, sufficiently demonstrated his ability in engineering, to almost immediately place him in the foremost rank of the profession and Mr. R. E. Richardson who so ably assisted Mr. Pierce, more particularly in the planning of the wiring of the grounds, has also shown that he is no novice in the business. **The Electrical Engineer** predicts a successful career, for the new firm and wishes them the fullest measure of success.

Warren Webster & Co., with works at Camden, N. J., and Chicago office at 2 Canal street, report among the many orders received for their Webster vacuum feed water heater and purifiers, one from the Pullman Palace Car Co., Pullman, Ill., for three more Webster vacuum feed water heaters and purifiers, aggregating over 5,000 h. p., to equip their entire works; also for the Williames vacuum system of steam heating, so as to utilize their waste exhaust steam for heating purposes, without back pressure upon the engines. Past orders received from this company amounted to 2,700 h. p., installed in their plant at Pullman, Ill., during the past four years. Warren Webster & Co., claim to have the best methods for correcting feed water for boilers, and for utilizing exhaust steam for heating purposes, without back pressure upon engines, giving the best results upon all points of economy. They built their present new works at Camden, N. J., last year, and are now commencing an extension of 60 x 65 feet in their wrought iron department. Examinations and estimates are made by them free of charge.

C. E. Brockman, of Mt. Sterling, Ill., is in the market for an electric light plant and water works.

The City of Duluth has sold $300,000 water and light bonds, which will be used to establish an independent city water plant unless prevented by injunction proceedings, which are threatened.

McLean Armature Works, Chicago, are making a specialty of rewinding burned out armatures for any system. They also do electrical repair work of all kinds. Mr. McLean's practical experience with nearly every known system gives the firm quite an advantage in that class of work.

Mr. J. M. Atkinson, long and favorably known in electrical circles, has recently been appointed general selling agent for Sargent & Lundy, Monadnock Block, Chicago. Mr. Atkinson's wide experience in the electrical field will no doubt prove of great service to him and the firm he now represents.

Copper Wire Thieves.—The large quantity of wires, cables and conductors still at the World's Fair grounds is quite a temptation to thieves. Recently the police arrested two men, leaving Jackson Park with a load of insulated wire. The men claimed they were hired by strangers to unload the stuff from a freight car and cart it away.

Kalamazoo, Mich., may find itself in the dark within a week or so, the City Council having terminated the contract with the Kalamazoo Electric Company, and voted to build a plant. Work has not yet been begun on the plant, and as great public opposition has arisen, the Council voted to submit the building proposition to the people at the Spring election to bond the city for $40,000 for such purpose. The City if it builds, would be left without lights, and the old company has been notified that it must continue to light the city for six months under the old contract, or take their lights from the streets. The company claims that the council will have to contract by Monday next or there will be no lights thereafter. It holds that its charter runs for twenty-two years yet, and it will not abandon the streets, whether it runs the lights or not.

THE ALTOONA MFG. CO.'S GREEN ENGINES.

Recent shipments and orders of the Altoona Manufacturing Co. include the following engines and steam power plants: One 80 H. P. engine shipped to Mr. J. T. Pugh of Philadelphia, for operating and lighting his new auger factory. One 125 H. P. engine to the Western Glass Co. of Colorado City, Col., for lighting the factory of the company and the city at large. One 80 H. P. engine to the New Castle Car Mfg. Co., New Castle, Pa., for operating and lighting their new street car factory. One 150 H. P. engine with steam power plant complete shipped to the Farmington Light & Power Co., of Farmington, Ill., for the central station lighting plant in that city. Two 175 H. P. special railway engines with boilers and steam plant complete shipped last week to the Lynchburg & Rivermont Street Railway Co. of Lynchburg, Va., which plant is now in process of erection. Orders received last week consist of one 60 H. P. engine for lighting the new Christ M. E. Church of Pittsburgh; two 50 H. P. engines for lighting the fine new McIntosh-Verner Building on Penn Avenue, Pittsburgh; two 150 H. P. engines with steam power plant complete for the Ringing Rocks Electric Railway Co. at Pottstown, Pa. These two engines are of interest to the electrical fraternity, owing to the fact that they are to be direct connected to two power generators of a design imported from Germany, and are the first engines in the United States that have been directly connected to this make of generators for electric railway service.

CURTIS RAILWAY MOTORS FOR BROOKLYN.

The most recent large order for car motors has been let to the Curtis Electric Manufacturing Company of Jersey City. The order was for one hundred and twenty equipments from the Brooklyn City R. R. Co., and is for the widely used 30 H. P. "Box" motor manufactured by the Curtis Company. These motors have given the Railroad Company excellent service during the past two winters, having run side by side with those of two other companies. The competition for this order was keen, and the awarding of it to the Curtis Company speaks well for the quality of its apparatus.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. MARCH 28, 1894. No. 308.

ON THE PROBABILITY OF IDENTITY BETWEEN SPECIFIC ELECTROSTATIC CAPACITY AND SPECIFIC ETHER DENSITY.

BY EDWIN J. HOUSTON, PH.D. AND A. E. KENNELLY, F.R.A.S.

THE following simple consequence of Maxwell's electromagnetic theory of light may have escaped notice, or if noticed and already published, does not appear to have found its way into current literature.

Assuming that the magnetic permeability of ordinary transparent dielectrics is sensibly equal to that of the ether in free space, it was pointed out by Clerk-Maxwell that as a necessary result of his electromagnetic theory of light, the specific electrostatic capacity of an isotropic dielectric medium should be equal to the square of its optical index of refraction for radiant energy waves of greatest length. This prediction is well known to have been fairly well verified in quite a number of transparent solid and liquid dielectrics, with notable exceptions in animal and vegetable oils.

But the index of refraction of a substance for a given wave-length is known to be the ratio of transmission velocity for such waves in free space to their transmission velocity within the body, and there is experimental evidence tending to show that it is the ether within a transparent substance which transmits light and not the molecules of the substance itself.

The mechanism by which ether transmits radiant energy is not known, even though it be granted to be electromagnetic, especially since the exact nature of the ether is itself problematical; but Fizeau in 1859[1] first demonstrated experimentally that the velocity added to light traversing a moving transparent body was not the full component velocity of the body in the direction of luminous transmission, but a fraction thereof, namely, $(n^2-1)/n^2$, where n is the index of refraction. This experimental result was verified by Michelson and Morley in 1886.[2] The natural interpretation of this observation, as pointed out by all three observers, appears to be that the ether is denser within the substance of a body than in free space, and that this mean specific density must be the square of the index of refraction. Such a relation is in conformity also with the ordinary formulæ for the transmission of disturbance through material bodies, namely,

$$v \propto \sqrt{E/D}.$$

If this indication of the Fizeau-Michelson-Morley experiments be admitted, *it then follows that the numeric representing the specific electrostatic capacity of a body must be equal to the numeric representing the mean specific density of the ether in that body.* Or in current notation, $v = 1/\sqrt{K}\,\mu$, and if $\mu = 1$, $n^2 = K$; and since $D = n^2$, $\therefore D = K$.

If the ether possesses inertia, this deduction appears to favor the view that electrostatic displacement and stress are of kinetic nature; that is, that they involve motion, whirling, for example, of the ether particles. On the other hand, if the ether be devoid of inertia, the argument is, perhaps, reversed.

A further inference from Maxwell's verified theory and Fizeau's interpreted experiment is that crystals have different mean ether densities in different directions. The following are a few specific ether densities according to the above view, and Klemencic's values :—

Air	1.000293
Hydrogen	1.000132
Carbonic acid	1.000492
Carbonic oxide	1.000347
Nitrous oxide	1.000579
Olefiant gas	1.000729
Marsh gas	1.000476
Carbonic disulphide	1.000450
Sulphurous acid	1.004770
Ether	1.003720
Ethyl chloride	1.007760
Ethyl bromide	1.007730

LABORATORY OF HOUSTON & KENNELLY,
PHILADELPHIA, MARCH, 1894.

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[1] Fizeau, *Ann. de Chemie et Physique* (III), Vol. LVII., 1859, p. 385.

[2] Michelson and Morley, *American Journal of Science*, Vol. CXXXI., No. CLXXXV., p. 377, May, 1886.

THE OUTLOOK FOR SMALL ARC LAMPS.

BY

W. S. Barstow

I have read with considerable interest the editorial on the above subject in the ENGINEER of March 14, in regard to the future introduction of small arc lights. That there is a very encouraging future for low tension arc lighting is even to-day apparent. The flexibility of a low tension direct current system is being practically recognized all over the country, and the low tension arc lamp was the only thing that remained to make a universal system. As we are now enabled to furnish arc lamps, incandescent lamps and motors on the same system and generators, we are rapidly approaching that stage in the business when our stations will become power houses, and current only will be sold, without reference to its use.

That arc lamps will be introduced from 50 candle power up I frankly confess is by no means settled in my mind. A lamp requiring 125 watts has proved itself, under ordinary conditions in Brooklyn, a somewhat doubtful success, due to the cost of trimming. The cost of renewals and attention to an arc lamp varies little whether we use a lamp of 2,000 candle power or 300 candle power, the only difference whatever being in the cost of carbons.

The efficiency of an arc lamp of 250 candle power as compared with an incandescent lamp or lamps of the same energy is necessarily low if used in a private house. The arc must be surrounded by a globe which will take away from it the characteristics of a light emanating from a single point. The efficiency of the light will be very much reduced by this globe, and will not be up to that of an incandescent lamp or lamps of equal energy. That arc lights requiring 200 watts are a commercial success has been demonstrated in the Brooklyn system, and we look to some future device for increasing the life of carbons to open the way for the other small arc lamps.

In this connection it might perhaps be of interest to state that we have closed a contract with the City of Brooklyn for 600 ornamental posts and lamps for lighting the streets. This, I believe, is the first large low tension installation in America, and will bring up our number of low tension arc lumps connected to the Brooklyn City system to 3,800.

SMALL ARC LAMPS.

BY

Elihu Thomson

The application of arc lamps on constant potential circuits such as are used for incandescent lighting naturally raises the question whether quite small arcs or arcs of very limited candle power may not become available at some time in the near future.

As far back as 1882 and 1883 the writer experimented with arcs using as low as 2 to 3 amperes and with a potential between the carbons of about 50 volts. An arc with 2½ to 3 amperes was readily obtained and the mechanism for feeding, accurately, the carbon of small diameter was worked out, but the great difficulty at that time was that no carbons could be had pure enough or uniform enough in structure to permit such arcs to be run steadily, and the feeding mechanism was naturally more delicate and costly than that used with larger carbons, while the length of lamp to accommodate such lengths of carbon as would provide for an eight hours' run was so considerable as to render the lamp ill proportioned.

Subsequently there was tried enclosing the carbons, made of short plates, in a chamber of glass with limited air supply or none at all. This gave better results but the carbons gave out enough impurities to obscure the glass in a moderate time. With very pure carbon the results might have been much better. The actual waste of the carbon was very slow and with a good arc length the light was quite steady. The great economy of light production in the arc is sufficient of a stimulus to make such efforts to obtain small arcs, of reasonably low candle-power worth the making. Such experiments were convincing as to the need of very pure carbons, a supply of which was not to be obtained. This need still exists so far as the writer is aware.

Very small arcs when burned in the air with ordinary carbons have a woeful tendency to rotation, a motion of the arc which has a very disagreeable effect on the character of the lighting and practically destroys its utility. The rotation seemed to be regularly performed by the arc in the crater of the positive carbon, casting the main body of light in a rotatory manner or a constantly changing direction. With a good quality of carbons arcs using from 160 to 200 watts are perfectly practicable even with the ordinary mechanism for feeding the carbons.

It is gratifying to discover a growing appreciation by station men and others, of the fact that the best results in arc lighting are dependent on the use of the finer varieties of carbon instead of the less perfect, though cheap, carbons so commonly employed. Even the low price carbons of to-day are, however, in quality very far ahead of the only available carbons of the pioneer days for which a good round price had to be paid. In fact, really fair carbons were a rarity in the years between 1879 and 1883 and many a plant was subject to condemnation when everything was right except the carbons available for use with it.

In fact, those who enter arc work to-day can never obtain an appreciation of the difficulties which were encountered and had to be overcome in making the arc light a commercial success. There was of course, an added prejudice against the light itself because it was a white light, or appeared bluish in relation to flames, torches, and such other "hereditary" night lights.

It is easy to account for such prejudice and it is difficult to see how it could have been avoided. For countless ages the human race had relied for night light on fires, torches, lamps burning fats or oils—and the sensorium had come to expect a night light to be orange or yellowish in quality and to be able to recognize no other to be in correspondence with hereditary expectation. Hence the sudden appearance of a white light at night, was a sort of shock which could only be assimilated in the consciousness as something uncanny, inspiring dread or distaste rather than the reverse sentiment. It was called a ghostly light or a ghastly one and its unsteady flashes and flickers recalled the terrors of the thunderstorm in the night with its bluish and blinding sheets. Burning in full daylight arc lights have really a yellowish aspect, showing a large proportion of such rays to be present in the arc.

It does not appear that the introduction of small arcs should have any serious effect on the use of incandescents in their legitimate field. It ought indeed to have in many instances an opposite effect in somewhat the same way that the introduction of arc lights often led to increased gas consumption, as the standard of sufficiency in illuminating created a demand for more light.

When the incandescent lamp was first brought out, predictions were heard that arc lighting would soon become substantially a thing of the past. The writer never felt that any such predictions were likely to be verified and continued to work assiduously in the arc lighting field believing thoroughly in its permanence. We may perhaps feel equally assured that even if arc lamps of as low power as 50 c. p. became a commercial reality there would still remain a vast field for the extension of lighting by incandescent lamps.

THE NEW 5,000 HORSE-POWER WATER POWER PLANT OF THE CONCORD LAND AND WATER POWER CO., CONCORD, N. H.

BY

A. C. Shaw.

I.—INTRODUCTORY.

For the past year considerable interest has been shown in the construction of the new water power plant of the Concord Land and Water Power Co., at Sewall's Falls, on the Merrimack River about three miles above Concord, N. H. Two reasons may be given for this unusual interest, first, that the plant when completed will form probably the largest water power in the country (outside of the Niagara Falls plant now in course of construction), and secondly, because in this plant will be tried for the first time the triphase system, which the General Electric Company have recently brought out. The plant has been in course of construction about nineteen months, the first sod being turned August 1st, 1892, and the water was turned on and the machinery started on February 28, last. To Mr. George F. Page, one of Concord's leading citizens, and well known in electrical circles as the president of the Page Belting Co., is due the credit of originating the scheme, and he entered actively into the enterprise as its chief promotor and backer. The power house, the machinery and the entire electric equipment has been designed by Mr. Eugene F. Carpenter, who has been the general superintendent of the company since its organization.

II.—THE DAM.

Naturally the first problem to be solved was the damming of the Merrimack River, no small undertaking, and the services of one of the best hydraulic engineers in the country were brought into requisition, the design for the dam being furnished by Mr. E. F. Smith, of Philadelphia, Engineer and Superintendent of the Schuylkill and Tide Water Canal, and the details of construction carefully carried out by Mr. Daniel Ulrich, of Newark, N. J. The dam is of the crib construction, filled in with broken stone, is 497 feet long, 67½ feet wide, and is 22 feet deep from the comb to the bottom of the foundations. About a

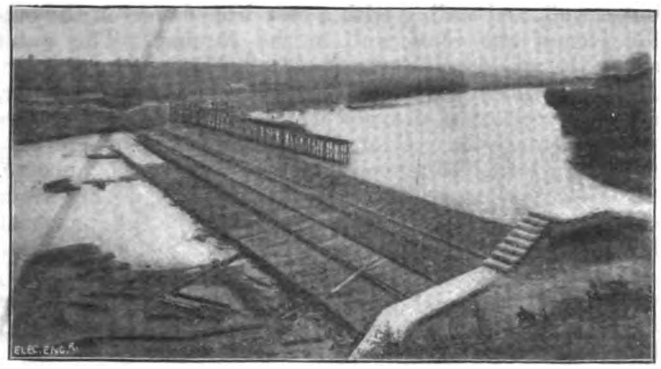


FIG. 1.—THE DAM ACROSS THE MERRIMACK RIVER.

million and a half feet of timber were used in its construction, and 20,000 cubic yards of broken stone, so that the dam is practically a stone dam, held in place by timbers. The fall of the water from the comb of the dam to the bed of the river below is 14 feet, and, as will be seen in the illustration, Fig. 1, is gradual, the water being allowed to flow over three or four easy drops and slopes, and pass away comparatively quietly on to the bed of the river. Two feet additional is gained by the natural slope of the river between the foot of the dam and the point where the tail race rejoins it, so that the total fall of water is 16 feet when the river is just flowing over the dam. The pond formed by the damming of the river, has an average depth of about ten feet, is 500 feet wide, and extends back three or four miles, though the company owns the water franchise as far up as Franklin, a distance of about 13 miles.

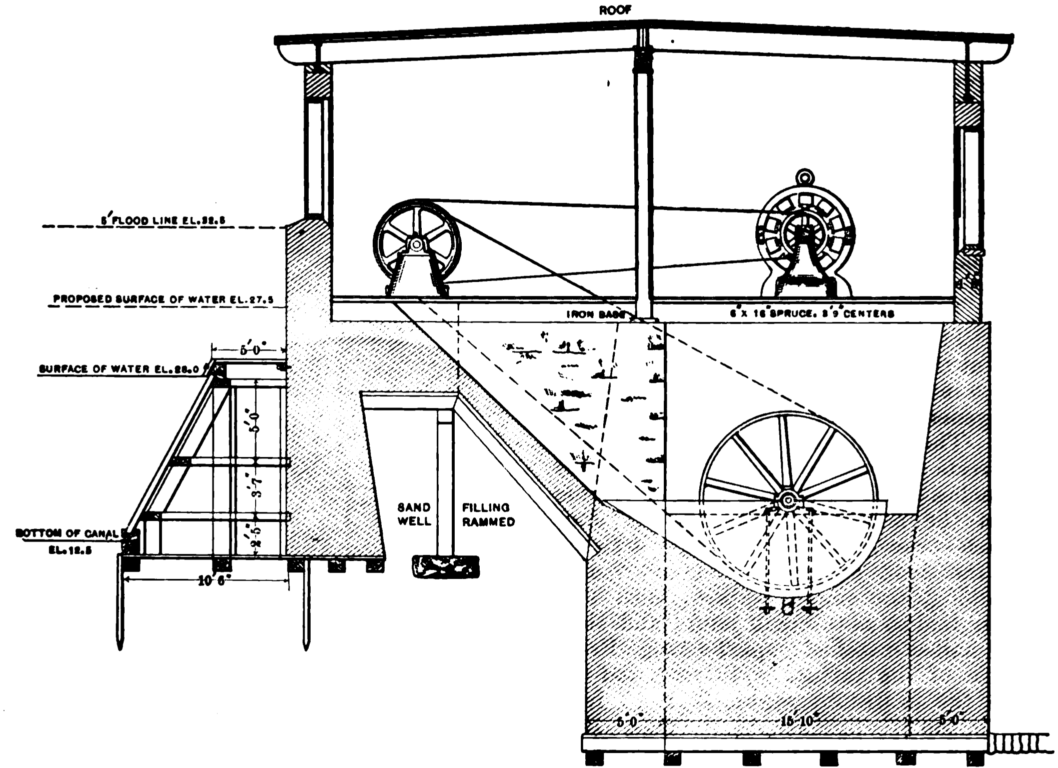


FIG. 3.—SECTION, SHOWING METHOD OF DRIVING.

The comb of the dam, protected on the edge by a steel fender, is 12 feet wide; then comes a slope of 10½ feet with a gradual fall of two feet, and then a direct fall of six feet on to an apron sheeted with $\frac{5}{16}$-inch steel plates. This apron is about 15½ feet wide, and is followed by another slope about 9½ feet wide, having a fall of four feet, and then a direct fall of about two feet, on to a lower apron protected with $\frac{5}{16}$ inch steel plates, twenty feet wide, and from which the water passes off on to the river bottom which is here filled with stone. The timbers which form the crib are 12″ x 12″ and 10″ x 10″ hemlock, laid 8 feet apart, and bolted together with 1-inch square drift bolts 22 to 30 inches long. The top layer of timbers is of Georgia pine, to which is spiked the outside sheathing of the dam, composed of 5-inch Georgia pine planking, laid parallel with the flow of the water, and one-half inch apart, so as to prevent damage from frost, and so that the timbers may be wet equally throughout. The front of the dam is of 4-inch hemlock sheet piling, each plank having been run through a Daniels planer, so that the edges join perfectly together, making a watertight wall. The dam is a beautiful piece of hydraulic architecture, and it is a pleasing sight to watch the water as it rolls smoothly over the various grades in a perfectly symmetrical manner.

III.—THE CANAL AND HEAD GATES.

The canal is 1,300 feet long, 60 feet wide at the surface and 10 feet wide at the bottom, with an average depth of about 11 feet, and is sufficient for all the power in the river. The sides are protected by a crib work, sheathed with sheet piling, on which eventually a stone wall will rest. The head gates were designed by Mr. J. R. Freeman, of Boston, are of a new pattern, and are set in walls of the heaviest and most solid granite construction. There are five openings, each provided with a

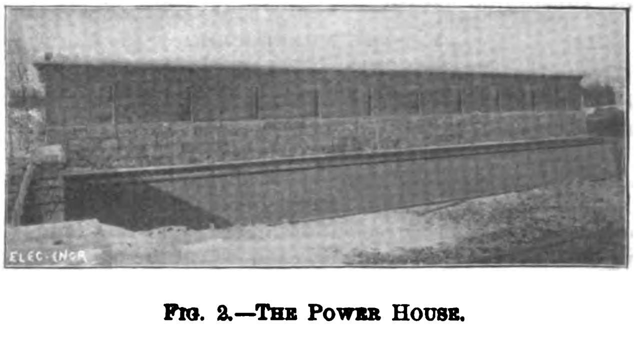


FIG. 2.—THE POWER HOUSE.

gate 10 feet by 10 feet, and the three centre gates are each fitted with an auxiliary gate 5 feet by 2 feet, as it would be impossible to open the large gates when there is any considerable difference of level between the river and the canal. The canal runs the whole length of the power house, its foundation wall forming one side, in which are set the fine immense penstocks, which convey the water from the canal to the wheel cases. On the front of this foundation wall and running its entire length, is a large forebay, made of timber, and fitted with a rack as shown in Fig. 2, to prevent pieces of wood and other floating material from entering the wheels. The rack strips are of a peculiar pattern, designed by Mr. E. F. Carpenter, and formed so as to let the maximum amount of water pass through a minimum of space. Each strip is rounded on the front edge, and has receding sides, the back of the strip being only half the thickness of the front, allowing 25 per cent. more water to pass then would ordinary rectangular strips. At the end of the canal with one end tied into the power house, is the waste weir, fitted with removable flash boards, so that any level of water can be preserved in the canal.

IV.—THE POWER HOUSE.

The power house, which has been designed for 2,000 horse-power, is of substantial mill construction without any ornamentation, is 160 feet long, 45 feet wide and 47 feet high from the foundation to the top of the roof. The foundation is composed of 10 inch by 10 inch ties, puddled into a hard pan bottom, with sheet piling at the sides. On top of the timbers is a layer of plank upon which rests the masonry. There are three longitudinal walls of masonry of separate heights and depths, tied together at every pulley pit. The canal wall, which is naturally not so deep as the others, owing to the difference in level of the canal and the tail race, is 6 feet 4 inches wide at the bottom, has the front face vertical, is 2 feet 10 inches thick at the top, and is 22½ feet high. The other two walls are 5 feet thick at the bottom, 3 feet at the top, and 26½ feet high. The canal wall is 6 feet 9 inches higher than the other two walls, to protect the generator room from possible inundation in time of flood. These walls are of solid granite and cement and on them rests the brick walls of the generator room, which are 20 inches thick, and built with solid lime cement. Resting on the masonry walls, are the floor stringers of 6 x 16 inch spruce, set 3 feet 9 inches between centres, supporting the floor, composed first of 4 inch matched spruce planking, thoroughly spiked, then two layers of tarred paper, laid so as to break joints, and then on top one inch blind nailed matched maple flooring. From the floor to the bottom of the rafters is 15 feet, and the roof is supported in the centre by eight 12 x 12 inch Georgia pine pillars on top of which are set iron caps. Into these are fitted the 12 x 16 inch roof stringers, to which are bolted the rafters. The rafters are of Georgia pine 6 x 16 inches, set 6 feet between centres, and the roof is composed of 3 inch matched pine planking, then 1 inch of lime mortar, then ⅞ inch pine boards, on top of which is 5 ply tar felt, and gravel. No device has been installed for heating the building, the supposition being that the heat thrown off by the machinery will be sufficient. The windows in the generator room are all double, and the whole construction throughout, though extremely plain, is of the most substantial nature.

V.—THE WHEEL ROOM.

The wheel room is 150 feet long by 15 feet 10 inches wide and 15 feet high, and is designed to accommodate five pairs of 39 inch horizontal turbines, four of which are now in position, of the well known Rodney Hunt type, manufactured specially for this work, by the Rodney Hunt Machine Co., of Orange, Mass. Each pair of wheels is contained in a case 8½ feet in diameter by 11 feet long, and will develop 400 horse power, each wheel being designed for 200 horse power. Each case is connected to the canal by one 8½ foot ⅜ inch steel penstock, passing through the centre wall, and ending with a cast iron flange on the outside face of the canal wall, in the forebay. The water leaves the wheel case through a 48 inch steel quarter turn, and passes through a steel draft tube 48 inches in diameter, set at an angle of 40 degrees from the vertical, and passes out horizontally into the tail race, the bottom end of the tube being bent into a horizontal position for this purpose.

These tubes are at all times full of water, the water backing clear to the wheels, thus getting the full power of the entire fall, without having the wheel submerged at the lowest depth, and enabling belt transmission to be used, instead of the ordinary noisy gearing and shafting. It is worthy of notice that when the station is in operation and the full power going through the wheels, there is almost no noise, except the usual slight noise of the belts, the wheels themselves running absolutely quietly. The shaft, 6½ inches in diameter and 29 feet long, extends through both wheels and both quarter turns, and is connected at one end by means of a coupling to the transmitter pulley, which is a heavy cast iron flywheel, 11 feet 6 inches diameter by 32 inch face, revolving at 150 revolutions per minute; Figs. 3 and 4 show the arrangement of the turbines and shafting. Each shaft is entirely separate from the others, making separate units, and each unit can be used separately, or combined by means of friction couplings on the floor above.

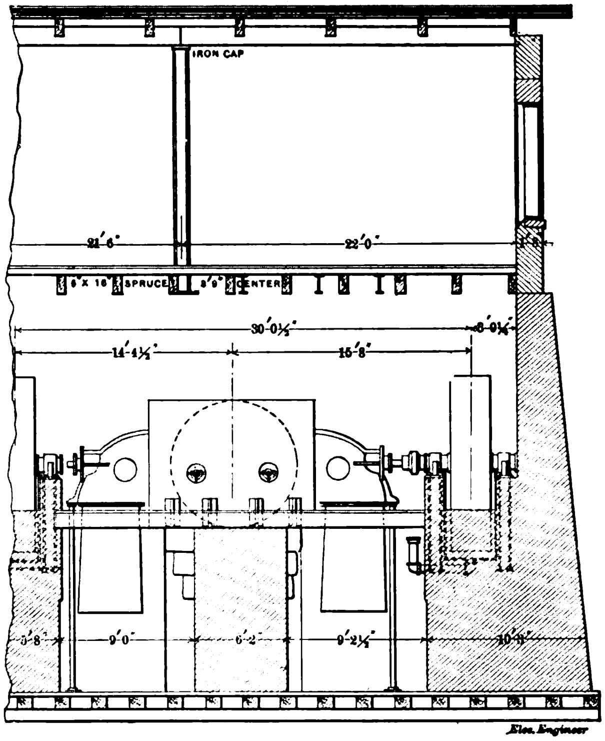
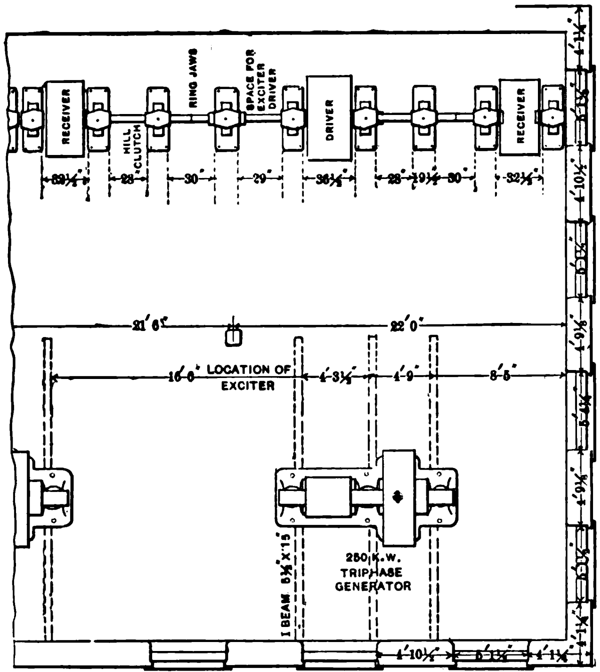


FIG. 4.—PART ELEVATION SHOWING TURBINE ARRANGEMENT.

Each pulley runs in a boiler-plate watertight belt pan, which extends to the centre of the shaft, so that even should the wheelroom become flooded, there would be no damage to the belts, unless the water should rise higher than the shafting, a contingency extremely improbable, as ample pump capacity is provided to take care of any water leaking or percolating into the wheel room. A governor, electro-magnetic in its action, is attached to each wheel, and the gates can be opened either by a hand wheel in this room, or by an extension shaft from the room above. The draft tubes are tightly set in the tail race wall, so that even should the water back up in the tail race, there will be no leak into the wheel room, and enabling the wheels to be run in any condition of the river. The power is transmitted by 32 inch double oak tanned waterproof belts, manufactured by the Page Belting Co., of Concord, N. H., through notches in the centre wall to receiving pulleys on the main shaft on the floor above, as shown in Fig. 5.

VI.—THE GENERATOR ROOM.

The generator room, which contains the generators and the shafting, is 150 feet long by 40 feet wide, and 15 feet high. The shafting which makes 300 revolutions per minute, is of hammered iron, and is 5 inches in diameter, set in solid masonry foundations, and equipped throughout with ring oiling bearings. The main receiving pulleys are 5 feet 9 inches in diameter, by 32 inch face, and are supported on a quill, with special quill bearings, so that the water-wheels can be started up independently of the shafting. The pulleys are fastened to the shaft with taper sleeve arrangement, which obviates all necessity for key ways and set screws, and makes the shaft much more rigid. The rims of the large pulleys are 2 inches thick, and the whole shafting, in fact, has been made extra heavy, forming in effect one large fly-wheel, the inertia of which is an important factor in the regulation of the plant. This device has never before been employed and is original with Mr. Carpenter. Hill friction clutches are used throughout, by means of which any combination can be secured, the wheel at the one end of the power house being capable of being used to transmit power to a generator at the other end of the power house if so desired. The generator room will contain at present seven Thomson-Houston 50 light arc light dynamos, and six 250 kilowatt triphase generators, the second plant to use the triphase current in this country. These generators will furnish current for incandescent lights, power, heating and cooking, all of which is at present being done from the company's circuits. It is an interesting fact that all the classes in the public cooking school in Concord, are being taught with electric cooking apparatus, supplied by the New England Electric Heating Co., of Boston. The voltage of these triphase generators is 2,500, and the voltage at the centre of distribution in Concord, 2,200, where it is transformed to 110 volts, at which pressure it is used for the purposes enumerated above. The company is now operating about 5,000 incandescent lights, 250 arc lights, and 400 horsepower in motors, all of which will be on the triphase circuits after April 1. One great advantage of triphase motors is the entire absence of commutators or brushes. These motors cannot be burned out or overloaded, and are practically transformers with a revolving secondary coil. The electric apparatus is all manufactured by the General Electric Company, the generators and motors having been designed by Dr. Louis Bell, who has had special charge of the development of this type of apparatus.



Elec. Engineer

FIG. 5.—PLAN OF DYNAMO ROOM.

VII.—OUTSIDE WORK.

THE wires conveying the current leave the power house from the Merrimack River end, and at once a serious difficulty was encountered and successfully overcome by Mr. Carpenter, in the necessity of crossing the river. Two 40 foot poles were erected on each side of the river, twelve feet apart, to carry the wires over the span of 475 feet. The cross arms are 25 feet long, and each is composed of three beams, the two outside ones being 8 x 8 inches and the other one 6 x 10 inches, forming a cross arm of 26 inches in width. Two of these cross arms are used, one 3 feet above the other. Each wire is fastened to 7 glass insulators, set in two rows, in such a way that the wire runs straight through between them. The wire used is No. 4 silicon bronze triple braided, and each wire is 3 feet distant from the other, and is calculated to stand an ice load up to 3 inches in diameter. There is a drop of 25 feet in the span over the centre of the river. After crossing the river, the wires are conveyed on ordinary cedar poles, thoroughly braced, and follow the Concord & Montreal Railroad to the city almost four miles distant. There is no wire tower on the power house, each wire passing through a porcelain tube in the brick wall.

VIII.—THE COMPANY.

Col. C. C. Danforth is president of the Company, Mr. Herman J. Odell, treasurer, and Mr. Eugene F. Carpenter, superintendent, and the following are directors: Messrs. J. C. R. Peabody, Winthrop Coffin, A. A. Glasier, C. C. Danforth, H. J. Odell, F. S. Streeter, F. W. Prescott, Chas. T. Page, and J. T. Fernald. The capitalization of the company is $600,000 stock and $450,000 in bonds, all of which is subscribed.

The plant is an extremely interesting one as it is probably the largest waterpower of the kind in existence in practical operation. It will be extremely economical to operate, as the whole plant can be run with three men at the power house, two linemen, two trimmers, one bookkeeper and a superintendent. The company owns 800 acres of good building ground in the vicinity, 15 of which is in mill sites, on the banks of the canal, which can easily be extended, and the 3,000 horsepower available over and above the power required for the electric plant, can be delivered at a minimum expense.

THE COPPER-ZINC ACCUMULATOR.

BY

Chas. J. Reed

IN the concluding article of Dr. Paul Schoop in THE ELECTRICAL ENGINEER of March 14, he describes a furnace for oxidizing and reducing copper plates in about three hours. It may be of interest to some to know of another, quicker process which does not infringe the Brush or Faure patents.

About six years ago while experimenting on the resistance of copper oxide and sulphide, the writer found that a thick wire or sheet of copper could be entirely converted into sulphide in a few minutes by suspending it at a temperature below a red heat in the vapor of sulphur or in melted sulphur. The process could be stopped at any required depth and the resulting sulphide retained the form of the wire and was perfectly uniform and smooth, but uniformly expanded. This sulphur could be burned out in a few minutes in a Bunsen or other oxidizing flame. No commercial use for the process was known to the writer at that time and it was never patented.

THE ELECTRIC RAILWAY AND ILLUMINATING PLANT OF THE MILWAUKEE STREET RAILWAY COMPANY.—III.—(*Concluded.*)

BY

Otto Frick

The Electric Railway System ; Track and Line.—The Milwaukee Street Railway Company have a model power station. They have bestowed the same care on the construction of their tracks and overhead lines as in the choice of the cars, shops, barns, etc., and have succeeded in rendering their lines and service second to none. The track is double throughout, and built mostly of 69 pound girder rail from the Illinois Steel Company, Chicago, Ill., and the Johnson Company, Johnstown, Pa. The rails are spiked to the cross-ties placed two feet apart, and the rail joints are made extra strong by heavy 30-inch six-bolt fishplates. By this means a very solid and smooth road-bed has been obtained. The construction of the curves offers some special interest; all single centre curves have been replaced by the so called compound transition curve, the construction of which is explained in Fig. 14. As will be seen, the curve is formed with a radius of decreasing length; the first radius is 200 feet, the second 100 and the third 66⅔ feet, each with a five foot chord. The central radius is made as large as the street allows; in this instance it is assumed to be 40 feet. By this construction a smoother transition to and from the curves is obtained, not only agreeable to the passengers but also favorable both to wheels and track.

The overhead construction has received the same careful attention. To support the trolley wire, centre poles as well as side poles are used, with span wires at intervals of about 125 feet. As to the respective advantages of the two systems, the Milwaukee installation shows that both can be arranged in an ornamental way, but should any preference be given, from an artistic point of view, it would be to the centre poles construction. For practical results, the span-wire suspension is undoubtedly superior, on account of its greater flexibility ; improvements are steadily being introduced, however, to get a less rigid and more substantial attachment of the trolley wire to the centre poles. The worst feature of the trolley system is the arrangement necessary to support wires and switches at curves and crossings, and the only way to make them appear as unobtrusive as possible, is by a systematic disposition and a neat, careful mounting of the supporting span wires. Figs. 16 and 17 are diagrams of span wire arrangements for a single curve and for a complicated case of a crossing and two curves. Four extra heavy poles are placed at four street corners, and, by means of diagonal span wires, hold an iron ring over the centre of the street, from which radiating wires keep the curves in position. In some places the trolley wire consists of No. 2 B. W. G. hard drawn copper, replacing the original No. 4 silicon bronze which was found to be too brittle. The wire is placed 25 feet above the ground, with a maximum dip of 18 inches. Parallel with it and connected to the trolley wire at every fourth pole is the auxiliary main of insulated No. 0 wire.

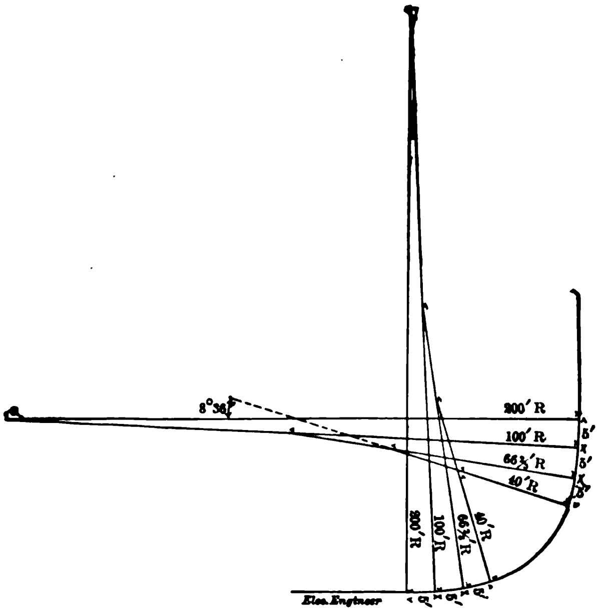


FIG. 14.

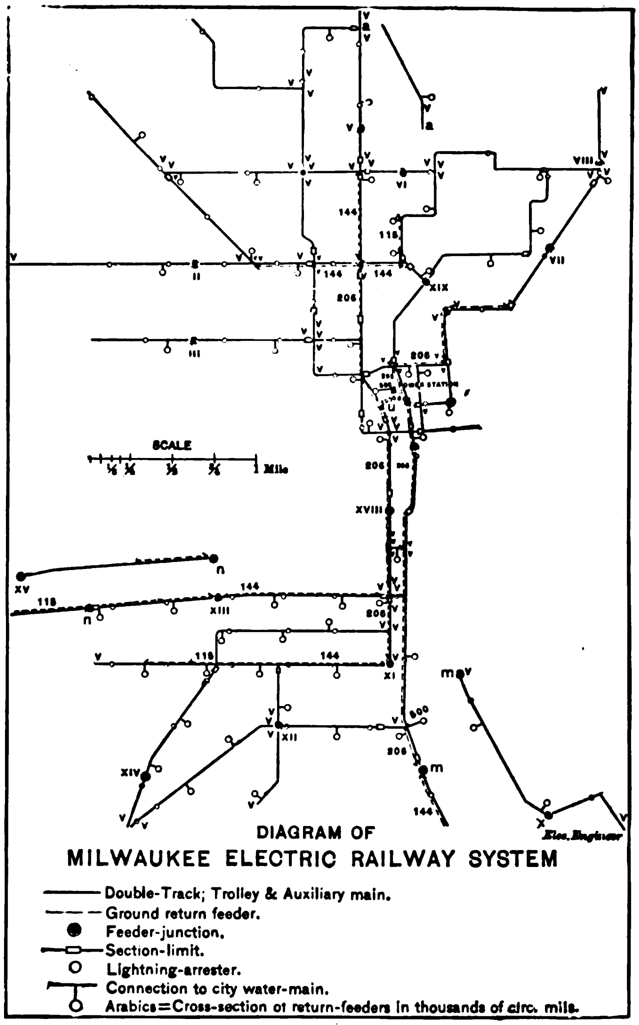


DIAGRAM OF
MILWAUKEE ELECTRIC RAILWAY SYSTEM

——— Double-Track; Trolley & Auxiliary main.
– – – Ground return feeder.
● Feeder-junction.
—▭— Section-limit.
○ Lightning-arrester.
Connection to city water-main.
Arabics = Cross-section of return-feeders in thousands of circ. mils.

SECTION OF FEEDERS.

I. = 500,000 cir. mils.
II. = 200,000 " "
III. = 250,000 " "
IV. = 200,000 " "
V. = 200,000 " "
VI. = 200,000 " "
VII. = 100,000 " "
VIII. = 250,000 " "
IX. = 300,000 cir. mils.
X. = 350,000 " "
XI. = 700,000 " "
XII. = 400.000 " "
XIII. = 650,000 " "
XIV. = 350,000 " "
XV. = 350,000 " "
XVI. = 150,000 " "
XVII = 100,000 cir. mils.
XVIII. = 300,000 " "
XIX. = 200,000 " "
M. = 600,000 " "
N. = 700,000 " "
U. = 700,000 " "
Z. = 300,000 " "

FIG. 15.

The whole trolley net-work, shown in Fig. 15, is divided into independent sections, to allow any part to be cut out in case of necessity. For this purpose the trolley wire is separated at convient points by circuit breakers of vulcanite fibre, each section receiving its current from the generating station by underground feeders, at the end of which a special switch is attached to the pole. The feeders are run in Edison tubes and, as far as possible, placed two or three in one tube; their cross sections in circular mils will be found in the table adjoining, Fig. 15. Numerous lightning arresters have been placed along the lines, but up to the present time those in use have not worked satisfactorily and other types will be tried.

One of the troublesome parts of the whole system is in the return-circuit, influencing, as it does, telephone, telegraph and other metallic conduits in the neighborhood of the track. In Milwaukee it has caused the same annoyance as elsewhere, but thanks to the radical precautions now taken, it seems as though these troubles had been so far reduced as to be practically of no importance. To obtain this result, the loss of potential in the return circuit has been lowered by carefully bonding the rail joints, using extra return feeders, connecting the distant parts of the city directly with the power station, and, finally, by abundant connections between the rails and the city water-mains. The bonds are double, and made of 36-inch galvanized iron wire, $\frac{5}{16}$ of an inch in diameter. The ends of the wire are bent, a counter-head slipped on, and, after thoroughly cleaning the contact surface of the rail, the wire ends are firmly riveted to the rail, securing a perfect contact. At every fourth joint cross-bonds connect the four rails. The return feeders are made up of bare copper wires, No. 0, 00 and 0000, respectively, frequently joined to the rails at intervals of 200 feet between the ends of the feeders. They are placed in wooden channels, filled with a mixture of pitch and tar in a proportion of eight to one, which possesses the quality of being elastic at all temperatures and protecting against corrosion by electrolytic action. The connections to the water-mains are made in over fifty places. The pipe is well scraped and cleaned, an iron ring is tightly fastened around it, and a $\frac{3}{8}$ inch galvanized iron cable connects the ring with the track. In the neighborhood of the power station a heavy cable of 500,000 circular mils takes the current from the water pipe back to the generators.

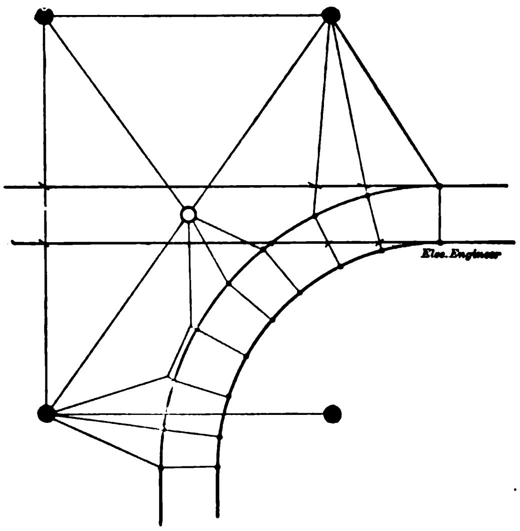


FIG. 16.

These connections have not only proved to be a perfect remedy for the troubles from the leaking currents between rails and pipes through the earth but have also lessened the loss of energy in the return circuit. Their influence may be explained by reference to Fig. 18. Here let the line *a b* represent a length of track, through which the return current is flowing from *a* to *b*, causing a certain difference of potential between these points. Small leaking currents will pass from the rail through the earth to enter the rail at another point, but on account of the resistance offered, these currents are exceedingly small, and as they are distributed over a large surface, their electrolytic action is quite inappreciable. Now suppose that near the track and parallel with it a water pipe is laid, represented by line *c d;* the resistance along the path *a c d b* will be considerably lowered, and a greater part of the return currents takes this path. As the resistance of the pipe is insignificant compared with that of earth paths *a c* and *b d*, the main loss of potential will occur in these parts, so that between *a* and *c*, and *d* and *b*, respectively, the difference of potential will be nearly half of that existing between *a* and *b*. Thus the amount of current leaking through the earth may be said to be proportional to this difference, and it becomes evident, that the only way to check the earth current is to bring pipe and rail to the same potential. By directly connecting them through metallic conductors, this may practically be accomplished. It is true that the resistance along *a c d b* is lowered, increasing the current through the pipe; but, on the other hand, the total loss of potential between *a* and *b* is not only lowered but the main loss along the path *a c d b* takes place in the pipe, and only a very small part of it in the two stout conductors between *a* and *c* and *d* and *b* respectively. By this means the potential of the whole track becomes very nearly equal to that of the neighboring pipe, and consequently there is no tendency for the currents to flow from one to the other through the earth, and both are thus protected from electrolysis. Measurements taken show that the proportion of current through the return feeders and through

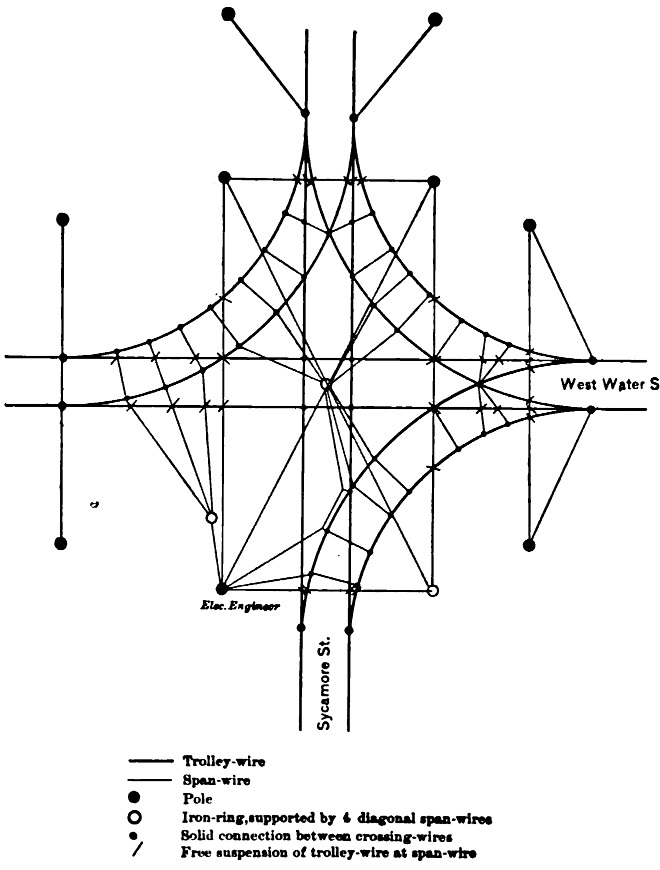

West Water St.
Sycamore St.
Elec. Engineer
Trolley-wire
Span-wire
● Pole
○ Iron-ring, supported by 4 diagonal span-wires
• Solid connection between crossing-wires
/ Free suspension of trolley-wire at span-wire

FIG. 17.

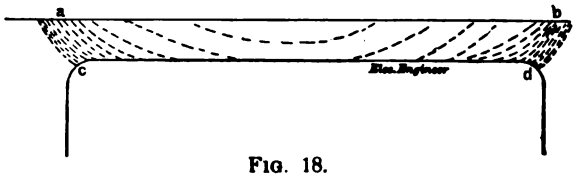


FIG. 18.

the water mains is the same in wet as in dry weather, thus demonstrating the efficiency of the system.

Rolling Stock.—The cars of the company are of no less than twelve different types; since the disastrous fire in December, 1892, however, which destroyed over 100 cars, those of the McGuire and Brill companies predominate. The motors used are of the Edison, No 8 double reduction, and No. 14 single reduction 15 h. p. types, with a small number of Westinghouse make, and each car is equipped with two; the Westinghouse and single reduction motors are wound for 500 volts, and regulated by the General Electric multiple-series controller, by which, at the moment of starting, the two armatures are put in series, and the magnet coils directly connected to the 500 volt circuit, thus creating an exceedingly strong torque. When once started the two armatures are connected to their respective magnet coils and variation in speed is obtained by different combinations of the magnet coils. The double reduction motors are built each for 250 volts and always work in series, variations in speed being obtained by the use of resistances. The double reduction motors, although being much more noisy than the others, have the advantage of requiring very little repair outside of the gearing. To transmit the power to the car axles spur gears are used and raw-hide pinions are now being introduced on the motor axles, replacing the steel pinions first in use. The latter are noisy and in breaking are liable to destroy the whole motor.

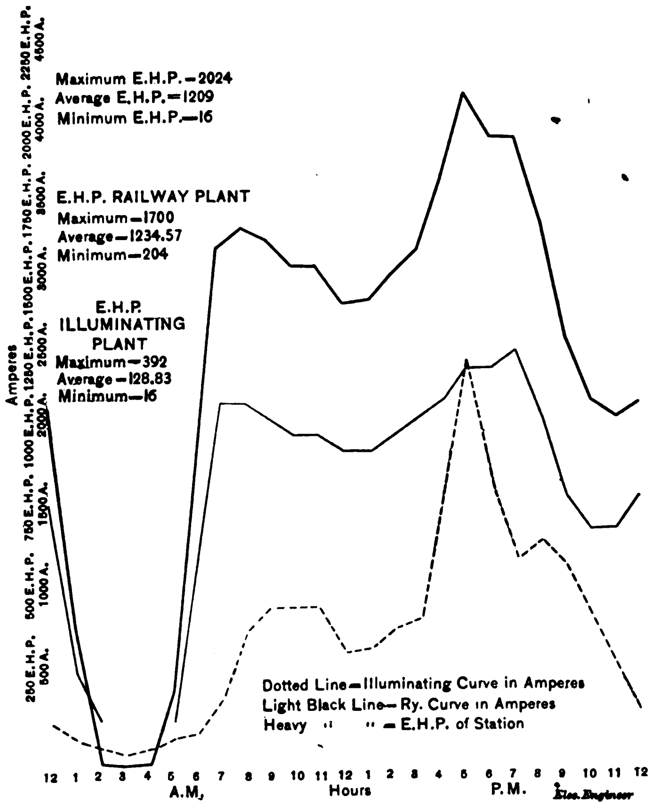


FIG. 19.

For the housing of the cars five barns have been erected. The largest, at Kinnickinnick avenue, has room for over 100 cars, distributed over thirteen tracks; the others have from six to ten tracks. These run over pits, electrically lighted and heated by steam. In winter the cars are run over these pits; the heat registers are opened and the hot air melts away the snow and ice on the truck in a few minutes thus facilitating the cleaning of the car. Adjoining the Kinnickinnick barns are the repair-shops, and a large store-room, where over two hundred articles, employed in the working and maintenance of an electric railway, are stored in admirable order, ready for immediate use.

Operation.—There is completed at present about 100 miles of track on which about 125 cars are now running. The lighting plant is operated in conjunction with the railway, supplied by the same battery of boilers, and under the same supervision. The adoption of the direct driven type of generators necessitated changes in the operating force, doing away with engine and dynamo tenders and engaging in their place unit tenders, and considerably reducing the force required. The orders are given from the switchboard by signal, one engineer only being in attendance on each floor. This works very satisfactorily and prevents all clashing between the different employees. Fig. 19 shows the peculiarity of the output from a combined lighting, power and railway plant, using a common boiler plant and independent units. It will be noticed that the railway system is totally shut down between the hours of two and five a. m., and that the lighting curve closely follows the contour of that of the railway.

This installation is the pioneer direct driven, triple compound steam electric generating plant for railway, power and lighting purposes. The delays consequent upon primary construction were so great that a temporary plant had to be operated while the permanent structure was being completed, creating confusion and disheartening not only the railway company, but the public as well, the ordinary layman not taking into consideration the fact that even after a design is studied out thoroughly it requires months for its fulfillment, to say nothing of the testing necessary to bring out needed improvements and alterations. This was further aggravated by adverse criticism and free advice especially furnished by manufacturers of standard apparatus that already had a reputation and a market, but, like that of all pioneers, missionaries, or experimenters, this work has been largely for the benefit of others than the persons concerned; so much so that now several manufacturers have similar apparatus which they consider free from any imperfections the original plant may have had.

It would be greatly to the advantage of the industry in general if the Milwaukee Street Railway Company would see their way clear to allow a crucial test of their very complete installation by some well-known and independent expert. It is a remarkable piece of work and not only the designers, but the engineers, electricians and manufacturers that carried it through are to be highly complimented.

AN ILLUMINATED LIFE BUOY.

A TRIAL has been made at Kiel by the German war vessel *Worth* with an electrically lighted life buoy, the invention of Capt. Melter. The buoy was thrown overboard when the vessel was proceeding at a speed of about sixteen knots. For about twelve seconds it was lost in the eddy currents caused by the screws of the vessel, then reappeared and remained in sight. The experiments were so successful that it is probable that the buoy will be adopted generally in the German navy.

A MUNICIPAL PLANT FOR MARBLEHEAD.

THE town of Marblehead has voted almost unanimously in favor of the establishment of an electric lighting plant. The report as accepted provides for a mixed system of arc and incandescent lamps for the town and arc lamps for the Neck. The sum of $10,000 has been appropriated for a beginning. The balance of the cost, estimated at $50,000 will be bonded. The committee of construction consists of William J. Goldthwait, Thomas W. Tucker, Henry C. Sparhawk, John B. Litchman and Benjamin J. Lindsey.

THE POSTAL TELEGRAPH CO. has decided to place its wires underground in St. Louis and will use the Sutter conduits there, in the form of cement lined iron pipe.

THE DISRUPTIVE STRENGTH OF INSULATING MATERIALS.[1]

BY

M C Canfield.

AND

F. George Robinson.

In the construction of electrical machinery two things are required to secure good insulation. First, high insulation resistance, and second, great disruptive strength, that is, the ability to withstand electrical pressure without breaking down or being punctured.

The subject of insulation resistance has been pretty generally studied and appreciated for many years. But the question of disruptive strength, while no less important, has been almost neglected and the data available are not at all complete. Tests of disruptive strength have been made by using a static charge of electricity as a means of obtaining the E. M. F., desired. This method was used by the late Dr. J. B. Williams.[2] The value of this method of testing is somewhat doubtful as the materials tested are apt to show very different results if there is *energy behind* the E. M. F., as is the case when the source of E. M. F. is capable of supplying a current, instead of having merely the infinitesimal quantity of a static charge.[3] The best data on this subject are those recently published by C. P. Steinmetz.[4] He, however, gives no facts concerning cotton and silk covered wires which go to make up the most expensive and vital parts of almost all electrical machinery.

The insulation resistance of cotton and silk covered wires under various conditions has been investigated by T. T. P. Luquer,[5] but no definite information in regard to their disruptive strength is available and with a view to getting data upon this very important point, the following investigation was undertaken.

The materials tested were ordinary magnet and armature wire with silk and cotton insulation, both single and double covered. The same materials were also tested after being shellaced. The wires tested were of three sizes: Nos. 22, 16 and 10 B. & S. wire gauge. These sizes were selected as covering the range of those most used in electrical machinery. Tests of vulcanized fibre, press-board, vulcabeston, paper and mica were also made.

The tests were made with an alternating E. M. F. of 130 complete periods per second. A Slattery alternator of ten horse power working with a Stanley transformer of the same capacity supplied current at 100 volts to a Swinburne step-up transformer. This was an oil-insulated transformer, of the hedge-hog type, capable of supplying a mean E. M. F. of 50,000 volts. By regulating the field current of the alternator this could be varied from zero to its full value. The E. M. F. was measured by a Kelvin electrostatic voltmeter having a range from zero to 12,000 volts. This was connected to the terminals of the secondary of the transformer so as to measure directly the E. M. F. applied to the materials tested.

The wires were tested as follows: Hard wood spools, two inches in diameter and four inches long between shoulders were made. On these were wound two layers of each specimen of wire. One end of the bottom layer was connected to one terminal and one end of the upper layer was connected to the other terminal of the secondary of the transformer. The field circuit of the alternator was then closed and the field current rapidly increased until the insulation broke down. The breaking point was shown by the voltmeter needle dropping back to zero and the hiss of the discharge; the position of the needle at the moment of breaking being carefully noted. The field circuit was then opened and another specimen inserted.

In testing wire covered with shellac the same size of spools was used. After one layer was put on it was coated with the best orange shellac and then baked. When this became thoroughly dry the second layer was put on and treated in the same way. Wires boiled in paraffine were also tried. The two layers were wound in the usual manner and then placed for thirty minutes in boiling paraffine. In each test three or more spools of the same kind of wire were used and the figure given in the table is an average of the results obtained.

TABLE I.

Size of Wire B. & S. Gauge. 1	Description of Insulation. 2	Thickness of Insulation $= d$ mils. 3	Diameter of Wire mils. 4	E. M. F. $= v$ volts. 5	Gradient $= \frac{v}{d}$. 6
No. 22	S. C.	2.1	25.	608	289.5
22	D. C.	4.9	22.6	1005	205.
22	S. S.	1.0	25.	565	565.
22	D. S.	1.8	25.	742	412.
16	S. C.	2.6	48.9	697	268.
16	D. C.	4.8	50.1	1054	219.
16	S. S.	1.0	50.5	483	488.
16	D. S.	2.8	50.1	787	320.
10	S. C.	2.3	101.5	787	342.
10	D. C.	6.7	101.6	1375	205.
10	S. S.	2.4	101.1	850	354.
10	D. S.	1.6	101.3	670	418.

Table I gives the results of tests of armature and magnet wires. In column 1 will be found the size of wire used; column 2 gives the character of the insulation. The symbols used are as follows: S. C., single cotton; D. C., double cotton; S. S., single silk, and D. S., double silk. Column 4 gives the diameter of the wire in mils (thousandths of an inch); Column 3, the thickness of insulation also in mils; and Column 5 the reading of the voltmeter at the moment when the insulation breaks down. In the last column is given the electrostatic gradient which is the ratio between the E. M. F. required to break down the insulation and the thickness, or in other words it is the voltage required per thousandth part of an inch of insulation. The figures are given in terms of mils rather than millimetres because the former are always used to measure wires and insulation in America and England and the latter would give awkward decimal fractions.

TABLE II.

B. & S. Gauge No.	Description of Insulation.	Thickness of Insulation.	Diam. of Wire.	Mean E. M. F.	Gradient.
22	S. C.	2.0	25.	738	369
22	D. C.	4.5	22.7	1337	297
22	S. S.	.98	25.	523	534
22	D. S.	1.9	25.	971	511
16	S. C.	2.5	50.	874	358
16	D. C.	4.1	50.1	1167	285
16	S. S.	1.0	50.6	533	533
16	D. S.	2.6	50.2	1087	418
10	S. C.	2.5	101.6	850	340
10	D. C.	6.7	101.6	1412	211
10	S. C.	2.8	101.2	831	297
10	D. S.	1.6	101.4	750	468

The anomalous fact should be noted that the single silk covering of the No. 10 wire happens to be twice the usual thickness, hence it has a higher value than the double silk

(*Continued on page* 280.)

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[1] Thesis in Electrical Engineering, Columbia College.

[2] See *Transactions* American Institute of Electrical Engineers, Jan. 1892.

[3] This fact was pointed out by Professor Crocker (*Trans.* Amer. Inst. Elec. Engs., 1892, Vol. IX, p. 820.

[4] See *Transactions* American Institute of Electrical Engineers, Feb. 1893.

[5] See THE ELECTRICAL ENGINEER, Dec. 28, 1892.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. Kammeyer, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada,	per annum,	$3.00
Four or more Copies, in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies,		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

Vol. XVII. NEW YORK, MARCH 28, 1894. No. 308.

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HEAVY GASES IN INCANDESCENT LAMPS.

THE recent attempts to circumvent the claims of the Edison incandescent lamp patent have served, among other things, to bring out a type of lamp in which a heavy gas, such as chlorine or bromine, is admitted to the bulb. It is "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp" that Prof. Wm. A. Anthony last week read a paper before the American Institute of Electrical Engineers, which contains much that is suggestive. According to Prof. Anthony, an ideal lamp should be one that, while giving a high efficiency and reasonable life, should die by the rupture of its filament while still doing its best work. In order to demonstrate the effect of a heavy gas, Prof. Anthony gave the results obtained with lamps of the Novak type, made by Mr. John Waring, which contain a residual bromine atmosphere. A test was made with 8 vacuum and 8 bromine 50 volt 16 c. p. lamps, which showed that all the vacuum lamps had fallen more than one-third in candle power at the end of a 5-hours' run, at 65 and 70 volts, while the bromine lamps fell only 5 per cent. The current in the vacuum lamps had also diminished, showing an increase in the resistance of the filaments of over 5 per cent. Prof. Anthony, of course, admits that these experiments were performed under abnormal conditions, to save time, but insists that if the bromine will, when the filament is carried to such an abnormal incandescence, preserve the illuminating power of the lamp to such a marked degree, it would do so all the more at normal incandescence. Prof. Anthony also cites an actual life test of 8 vacuum and 8 bromine lamps, extending over 625 hours. Of the bromine lamps, one had failed in less than 200 hours, 2 more in less than 400 hours, and 2 more, or 5 in all, before the end of the test of 625 hours; but the candle power of the lamps still doing service was even higher than at the beginning. At 400 hours there had been no loss of efficiency. At 600 hours the efficiency had only fallen about 3 per cent.; and even this was partly due to the fact that these three remaining amps were, at the start, below the average efficiency. The vacuum lamps, on the contrary, had fallen in candle power nearly 20 per cent. at 400 hours and 27 per cent. at 625 hours. In efficiency they had dropped from 3.47 watts per candle at the start to 4.33 at 400 hours, and 4.8 at 625 hours. In order to account for this remarkable maintenance of candle power in the bromine lamp, Prof. Anthony discussed various theories regarding the actions going on in an incandescent lamp, which lead him to the belief that vaporization of the carbon filament takes place and that it is subject to the same laws as the vaporization of other substances and depends upon the temperature of the filament and not upon the absolute potential difference in the lamp. Regarding the particular action of the bromine gas, Prof. Anthony reasons that the saturated vapor near the filament is carried away by the currents of residual gas, leaving room for the formation of more vapor and further waste of the filament, but that there is a great difference in gases as to the formation of convection currents, and it is, therefore, not a matter of indifference what gas is used in the lamp chamber. Gases of great molecular weight, like bromine and iodine, possess the desired qualities and when used in proper quantities in the lamp chamber, not only prevent the blackening, but retard in some degree the waste of the filament.

As was to have been expected, the statements and theories of Prof. Anthony called forth a very lively discussion, in which some of the views put forward were challenged. Notably among those who thus took exception was Mr. John W. Howell, well known for his extended experience in incandescent lamp manufacture. Mr. Howell contended that a test on eight lamps of any kind afforded no sufficient basis for generalization and, judging from the results obtained in his own experience, he considered the 50 volt 32 c. p. vacuum lamps, which were subjected to a life test, to have been of very poor quality indeed. He based this assertion on quite recent tests made on lamps manufactured at Harrison, N. J., and tested at the factory at Lynn, in order to determine the relative character of the products of these two factories. These lamps showed a remarkable constancy and candle power, and showed that the lamps referred to by Prof. Anthony could not have been of the best quality. Mr. Howell also drew attention to another important point, viz., the fact that 50 volt 32 c. p. lamps were employed, instead of the more familiar 110 volt, 16 c. p. lamp. He insisted that the former presented probably the least difficulties in manufacture of any lamp, whereas the true test of the incandescent lamp maker's art lay in the production of a good 16 c. p, 110 volt lamp. The tests he had made on the Novak lamps did not bear out the statements contained in Prof. Anthony's paper. He also showed how quite analogous effects could be obtained to those resulting from the use of bromine, by allowing a proportional quantity of atmospheric air to remain in the lamp, but that this practice introduced other difficulties, which made its employment inadvisable. Mr. Howell also exhibited a number of lamps which showed a distinct carbon shadow, a point which was denied in Prof. Anthony's paper, and for which he cited numerous authorities. Prof. Anthony has done well to draw attention to this subject, and even if the results he gives are based on insufficient evidence they certainly are highly suggestive and would warrant further investigation. We are not yet at finality in the incandescent lamp art.

DISRUPTIVE STRENGTH OF INSULATING MATERIALS.

In a recent article published in The Electrical Engineer, Mr. H. C. Cushing, Jr., showed how marked has been the improvement in the quality of the insulation of wires employed for the distribution of current in buildings, over that which manufacturers were capable of furnishing some years ago. But while this steady improvement has gone on in the insulation of an important part of every current distributing installation, there has, strange to say been little, if any, marked change in the character of the insulation of the most vital part of such a system, namely, the dynamo itself. Armature and magnet wires are still covered with cotton and only in special cases is silk employed. In view of this state of affairs, the recent investigation of Messrs. M. C. Canfield and F. G. Robinson embodied in their Columbia College electrical engineering thesis printed in this issue is of more than ordinary interest and value. The tests made by these gentlemen bear directly on points which have been shrouded in considerable obscurity but which have a direct application in several important directions. They bring out clearly the fact that *porous* insulating materials are practically equivalent to the same thickness of air space; but *impervious* materials such as mica may be ten times stronger, and more. The steadily increasing employment of higher potentials, both in continuous and direct current machinery, also made it desirable to know the maximum allowable potential difference between adjacent layers or turns of wire in the case of high potential armatures, magnets and transformers, and also in special kinds of winding such as that recently brought out by Mr. Tesla. On this point also the reader will find most important data which can be directly applied to both present and future high potential work. What gives these disruptive tests special value is the fact that they were made with actual current and not with mere static charges of infinitesimal energy. By this means the investigators have anticipated the just criticisms made in the past on insulating material tests in which the static charge alone was employed. In view of this it is perhaps to be regretted that they did not also make tests with the usual static charges, in order to determine exactly the difference in the results obtained by the two methods. As it stands, however, the work is one of the highest practical importance. Columbia College is once more to be congratulated on the thoroughness and eminently practical character of its electrical engineering course of which the thesis above referred to is one the fruits.

THE FUTURE OF ELECTRIC COOKING AND HEATING.

It was suggested in these columns last week that the time had arrived for the systematic education of the public in the matter of electric cooking and heating. In the present issue we return to the subject, with a report of the encouraging results obtained during the past winter in the electric heating of street cars. When next winter comes around this work should be resumed in a large and energetic way, for not only is it a good method of car heating but it teaches people a neat lesson as to what they may enjoy in their homes if current be available. The first step in such a direction is to get electric heaters introduced for what may be called auxiliary heating. There are late days in Spring and early days in Autumn, when furnaces have been extinguished but when untimely cold makes everybody shiver. At such moments, the warmth of an electric heater, to be had in a moment, would be a perfect Godsend. This is particularly the case in Northern hotels where at all seasons of the year there are guests from Southern climes who want their rooms warmed, but for whom it is very inconvenient to make fires or start the whole heating system. Almost every hotel now has its electric plant in operation the year around and should afford, therefore, a market for electric heaters to render such a service.

Another means of getting at the general adoption of electric cooking and heating is to interest the architects, a very intelligent body of professional men. We believe that if a central station manager will take the trouble to invite the architects in his city to an electric lunch or dinner and will demonstrate to them how easy and convenient everything is, he will have the pleasure of seeing the new houses and office buildings very quickly provided with this new feature, and will find it entering into the specifications for future work.

The only point of caution and warning is to teach people to be reasonable in the use of current and to insist on the best wiring. With these and one or two other little points looked after, the local company that now engages in electric heating and cooking will soon reap a rich reward.

covered No. 10, and is a little above No. 16 double silk covered wire, the insulation of which is slightly thinner.

The next table, No. II gives the results of tests of the same wires when treated with shellac.

The results of tests of a few specimens of wires boiled in paraffine are given in Table III.

TABLE III.

B. & S. Gauge No.	Description of Insulation.	Thickness of Insulation.	Diameter of Wire.	Mean E. M. F.	Gradient.
22	S. C.	2.3	24.4	775	337
16	S. C.	2.8	49.2	1350	482

Comparing this table with the two previous ones we see that the E. M. F. required is higher than for corresponding wires not treated with paraffine.

In Table IV will be found the results obtained with various pieces of bristol-board, fibre, vulcabeston and press board. The apparatus used for these materials was similar to that used before. The specimens were clamped between circular brass plates $1\frac{1}{8}$ inch in diameter and $\frac{3}{32}$ inch thick. The edges of these plates were carefully rounded and the surfaces well polished. The plates were connected to the secondary of the transformer and the readings made as before. The materials were first tested under the ordinary atmospheric conditions, and again after being specially dried by heat. This treatment considerably increased the disruptive strength of the materials in most cases. Vulcabeston, however, was positively injured by baking, as might be expected.

TABLE IV.

Materials.	Thickness.	E. M. F. when cold.	E. M. F. when baked.	Gradient when cold.	Gradient when baked.
White Bristol-board ...	12.8	2966	3433	240.6	279
" ...	12.2	2983	3550	244.5	291
" ...	12.6	2975	3580	233.7	284.3
" ...	12.2	2833	3425	232	281.
Red fibre..............	30.9	9500	9900	307.5	320.4
"	30.4	8966	9900	295	325.6
"	31.0	9000	*	290.3	
"	30 9	8066	9700	261.0	314.
"	59.8	7700	9800	120.9	163.9
"	60.5	8200	9700	138.8	148.8
Black fibre............	70.9	7200	9700	101.5	136.8
Red Press-board.......	23.2	9400	*	405.2	
"	23.4	8650	9500	369.2	405.9
"	23.5	9400	*	400	
"	23.2	9800	9875	422.4	425.6
"	23.3	9400	10000	403.4	429.2
Vulcabeston	75.4	6000	5100	79.5	67.6
"	72.2	5500	4500	76.1	62.3
"	70.1	5700	5000	81.3	71.0
"	72.6	5750	5100	79.2	70.2
"	48.5	3700	3650	76.3	75.9
"	44.9	4700	3775	104.7	83.6
"	42.8	4000	3850	93.4	89.9

In the above table the marks * indicate that the specimens would not break down within the range of the voltmeter.

Tests of mica were also made. These were clamped between plates as was the case with the fibre. The specimens were broken down in two ways: First, by simply clamping the mica between the plates. In this case the coronal discharge mentioned by Mr. Steinmetz[6] was noticed, but in our opinion this is an element which introduces much uncertainty. To overcome this difficulty a number of pieces were tested by dipping the plates with the mica between them, in boiling paraffine and breaking down the mica when the paraffine was hard. This method was suggested by Professor Pupin and was found to entirely prevent the coronal discharge which is very objectionable, since it has the effect of gradually burning the insulating material and does not give a fair test.

TABLE V.

	Thickness.	E. M. F.	Gradient.
Mica without paraffine....	3.4	7600	2235
"	1.9	3200	1679
"	8.9	*	
"	11.5	*	
Mica with paraffine.......	1.7	5000	2935
"	2.0	5700	2850
"	2.7	5900	2185
"	2.7	6000	2222
"	2.8	5400	1929
"	3.2	6200	1938
"	3.1	5100	1646
"	3.4	6800	2000
"	4.6	4800	1043
"	5.1	6100	1198

* Above limit of voltmeter.

TABLE VI.—SHOWING THE STRENGTH OF DIFFERENT PAPERS.

	Thickness in mils.	E. M. F. when cold.	E. M. F. when baked.	Gradient when cold.	Gradient when baked.
White writing paper....	3.5	816	841	233	240
Light-brown paper......	3.9	841	845	216	217
Dark-brown paper......	4.5	741	841	165	187
Oiled paper.............	4.3	816		165	

Oiled paper was found to have no perceptible change in its disruptive strength after being baked.

For convenience in practical work Table VII shows the maximum differences of potential allowable between adjacent layers of different sizes and coverings of wires. With wires coated with shellac 25 volts can be added to single and double cotton covered and double silk covered wires. On account of the danger of mechanically injuring the insulation of single silk covered wire (usually about .001 inch thick), by putting on the shellac, it will hardly pay to use this method of extra insulation. If single silk covered wire must be used it would be better to boil it in paraffine than to use shellac.

In this table a factor of safety of four is taken, that is to say, the actual E. M. F. required to break through the insulation is four times that given in the table.

TABLE VII.

B. & S. Gauge No.	Insulation.	Max. Diff. of Potential allowable.
22	S. C.	From 100 to 150
22	D. C.	" 200 " 250
22	S. S.	" 100 " 140
22	D. S.	" 135 " 185
16	S. C.	" 120 " 170
16	D. C.	" 200 " 260
16	S. S.	" 70 " 120
16	D. S.	" 130 " 180
10	S. C.	" 140 " 190
10	D. C.	" 300 " 340
10	S. S.	" 160 " 210
10	D. S.	" 100 " 150

The conclusions derived from these tests are that the value of cotton and silk insulation depends almost solely upon its thickness. It also appears to be little if any better than the same thickness of air insulation. It is difficult to positively determine this point, because authorities differ so widely in regard to sparking distance in air[7]. When we consider, however, the fact that cotton and silk insulation are really very porous, there is every reason to expect that they are practically equivalent to air. The same is true of most kinds of paper, and other materials that are sufficiently porous to absorb water, for example. All that the cotton and silk do is to keep the wires apart and they merely require to be non-conductors themselves. It should be remarked, however, that silk covered and shellacked wires were found by Mr. Luquer, in the tests already noted, to be much less affected by moisture, and are therefore better on that account. This, however, merely means that cotton is very hygroscopic and absorbs much more water than silk and becomes a semi-conductor. If now we consider substances such as mica, glass, hard rubber, etc., which are perfectly non-porous and impervious even to gases, we find them to be far stronger against disruption than the same thickness of air or silk covering. Thus, compare No. 16 double silk covered wire in Table I with the second sample of mica in Table V. The former has a thickness of 2.3 mils of insulation on each wire making a minimum distance of 4.6 mils between two adjacent wires, and breaks down at 737 volts, while the mica is only 1.9 mils thick and gives way at 3,200 volts. The mica is less than half as thick and stands over four times the voltage! There is evidently a radical difference between these two classes of insulators.

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[6] *Trans.* Amer. Inst. Elec. Eng., Vol. X.

[7] See Steinmetz: "Note on Disruptive Discharge," *Trans.* Amer. Inst. Elec. Eng., Vol. 10, Table XV. and Fig. 9.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE CAYADUTTA ELECTRIC RAILROAD.

Early in the summer of 1891 a party of gentlemen, all more or less acquainted with men and matters at Gloversville, Johnstown and Fonda, New York, conceived the plan of building an electric railroad to connect these three thriving towns. Gloversville is a young city of 15,000 people, Johnstown has 9,000 and Fonda is an important station on the New York Central & Hudson River R. R. with a population of about 3,000. Many elements contributed to the difficulty of bringing this enterprise to a successful completion; among them the opposition of the Fonda, Johnstown and Gloversville (steam) railroad and the Johnstown, Gloversville and Kingsboro Horse R. R., the franchise and organization of the Gloversville Electric Street Railroad, and competition for franchises in Johnstown and Fonda by the Fulton & Montgomery County Electric R. R. Co., also hindered the incorporators in the earlier stages of the work.

The first step taken, therefore, was the securing of the Gloversville Electric Street Railroad Co.'s franchise and a bonus from the company for building the road. The Fulton & Montgomery County company was next defeated in both Johnstown and Fonda, and early in the spring of 1892 a corps of engineers in charge of Chief Engineer W. Boardman Reed began preliminary surveys for the road, which was to be built on a private right of way instead of the highway. This was made necessary on account of the proposed carrying of freight, which was to be a large part of the business of the new company. Not only was it impossible to procure franchises for the freight traffic along the main highway, but the grade of the highway would not permit it. A route was determined upon, the survey completed and specifi-

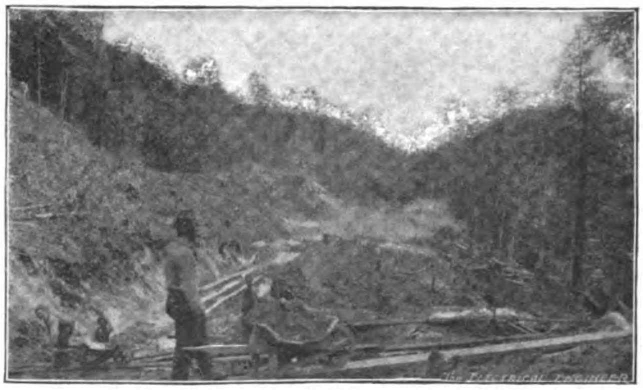
STREET SCENE IN GLOVERSVILLE, SHOWING ELECTRIC RAILWAY.

cations prepared for bids in July, 1892, and on August 2 the contract was signed for the entire building and equipment of the road. This contract contemplated the completion and operation of the road by Dec. 2 of the same year, but it was not until July, 1893 that the main line to Fonda was in operation. In the meantime the Cayadutta people had secured control of the Johnstown, Gloversville and Kingsboro Horse R. R, the equipment of which for electrical operation was nearly completed, had finished the rebuilding of the road, leased it and begun its operation from the Cayadutta power house on May 13, 1893. It has since been operated as a part of the Cayadutta system.

The construction of the main line, about nine miles long, involved the excavation of 175,000 cubic yards of earth and rock, the building of three pieces of trestle, two iron bridges and about 1,000 yards of masonry. The track is of 56 pound T-rail, laid on 6 x 8 x 8 hard wood ties two feet between centres. The overhead line is of bracket construction with No. 0 copper trolley wire and six No. 0000 copper feed wires running from the power house in Johnstown to Fonda, five miles south, and four No. 0000 feed wires to Gloversville about four miles north. Besides the main line there is a two mile loop in the village of Johnstown and a four mile belt line in Gloversville. On unpaved streets T rail, planked, is used with satisfactory results, while on paved streets Johnson 80 pound girder rail is laid, spiked directly upon vulcanized Virginia pine ties.

The power house is in Johnstown on the bank of a bright, pure stream of water furnishing an ample water supply for the boilers and for condensing purposes. It is a substantial brick building about 70 x 90 feet, containing three 150 h. p. horizontal tubular boilers, one 300 h. p. and one 150 h. p. Russell four valve compound engine with condensers, pumps, heaters, etc., and ample room for the plant of General Electric M. P. 100 generators. The car house is a frame building 150 x 68 feet located in Gloversville, the headquarters of the company. There is a paved pit under the full length of each track.

There is one unique feature in regard to the rolling stock of this road worthy of especial note as indicating a line of advance in electric railway practice. The four cars which run over the main line between Gloversville, Johnstown and Fonda are 35-foot combination cars running always in the same direction and turning on a Y at each end of the line. First is the motorman's compartment, then a baggage room 8 x 8 feet, a smoking room of the same size, and a women's compartment 13 x 8 with a four-foot rear vestibule. These cars are very popular and have been found to be just the thing for interurban service on which they run. There are also eleven 18-foot vestibule cars for the local lines, four trailers and a summer equipment of five ten-bench and two twelve-bench open cars. The combination cars first referred to and four of the 18-foot cars were made by the Gilbert Car Mfg. Co., seven 18-foot cars and trailers by the J. G. Brill Co., and the open cars by the Ellis Car Co. McGuire, Brill and Taylor trucks are used. General Electric W. P. 30 motors propel the 18-foot cars and Westinghouse single reduction motors the 35-foot cars. All the closed cars are equipped with DeWitt sand boxes and Brill track scrapers. An important part of this road's equipment is the snow plough manufactured by the Massachusetts Car Co., of Boston. The snow falls in Gloversville and Johnstown are very heavy and the electric plow has won the highest commendation for its work this winter. It is a nose plow, the nose being three feet high and concaved, and is provided with wings.



Grading the Cayadutta Road.

The Cayadutta electric railroad has done an excellent business since it began operation, and the outlook for the future is good. The last of the opposition was ended last summer when a syndicate of Cayadutta people purchased the Fonda, Johnstown and Gloversville steam railroad. The roads have since been operated in harmony and the electric system will soon be leased on favorable terms to the steam road. The result will be the abandonment on the part of the Cayadutta road of its freight enterprise and the throwing into its hands by the steam road of the bulk of the passenger business.

All the company's lines are single track with turnouts. Cars are operated on the schedule exactly similar to those of steam railroads, instead of under certain regular headway as is usual on electric roads. Each conductor is provided with a time table showing the time each car is due at each turnout, and meeting points are indicated by a circle around the figures. There is probably not another electric railroad in the country operated so closely to schedule time. A record is kept of each trip's earnings and cars are taken off or put on as the traffic warrants.

Mr. T. C. Frenyear.

Most prominent in the inception of an enterprise which has revolutionized the railroad situation in Fulton County and has involved $2,000,000 worth of railroad property were Mr. T. C. Frenyear, at first secretary and for the past two years general manager of the Cayadutta company; Hon. Everett Smith, the first president of the company and at that time Mayor of Schenectady; Hon. J. Ledlie Hees, its first treasurer, now treasurer of the Fonda, Johnstown and Gloversville Railroad, cashier of the National Mohawk River Bank of Fonda and deputy state treasurer; and Hon. Jas. Shanahan, ex-state superintendent of public works and formerly president of the Cayadutta Electric Railroad and now president of the Fonda, Johnstown and Gloversville Railroad.

The enterprising management of the company last summer began the development of a beautiful park on its main line between Johnstown and Fonda. This Park covers about 25 acres of wild and picturesque country with a brook running through it. A dancing pavilion, refreshment stand, band stand and numerous summer houses, rustic seats, beautiful walks and pure cold spring water are among its many attractions. During the summer scarcely a day passed without one or more picnic parties enjoying the beauties of Cayadutta Park. It is intended also to make an artificial pond of three or four acres which will add much to the beauty of the place.

The Geneva (N. Y.) Electric Railroad will be in running order within sixty days. The line at first will cover about five miles of streets in Geneva, although the franchise provides for as many miles more.

ELECTRIC HEATING FOR STREET CARS.

The use of electric heaters for street cars propelled by electricity has already passed the experimental stage. They have been demonstrated during the past two winters to be both electrically and commercially successful and are now very generally adopted all over the country by street railway companies. At the present time over two hundred electric street railway lines in the United States are equipped in whole or in part with electric heaters. Comparative tests have been made between the electric heaters and the coal stove, and with most satisfactory results.

The cost of operating electric heaters depends upon the cost of current, and this varies greatly in different localities. The average cost, however, per car day is about 25 cents. At Niagara Falls, N. Y., the street railway company has 38 electric heaters in operation on its cars. The extra cost per day for coal burned to generate electricity to operate the heaters is 75 cents, and it is estimated that the total cost per car day is 18½ cents, or about 5½ cents in excess of the cost of operating coal stoves.

In figuring from a commercial standpoint, one must take into consideration the following points: Electric heaters are installed at different points in the cars, are attached to the seat riser, do not take up any passenger space, and the heat is more evenly distributed than by a coal stove; there is no odor, dirt, dust or smoke in connection with their use, and they require absolutely no attention from the time the car leaves the barn in the morning until its return at night, and then only to turn on and off the switch. The heat can be regulated to suit the conditions of temperature and weather. There is less risk of fire and the cars are not warped out of shape or the ceiling or roof burned, as is often the case when coal stoves are used; nor is the car cut or disfigured in any way. There is but one coal bin,—that which supplies the power house, no handling of coal at various points along the route, no handling of coal in the cars to increase labor for keeping clean and to necessitate the "touching up of fires" in cars at frequent intervals; all of which saves expense.

On elevated roads where cars are propelled by electricity and where all the disagreeable features of burning coal in locomotives in the midst of a city are done away with, policy would also dictate the removal of the same features from passenger cars. The cost of electric heaters at present is not excessive and the depreciation not so much as that of coal stoves.

During this winter the Central Electric Heating Co., have made an elaborate series of tests on the cars of various roads equipped with their heaters, in which thermometers were placed in various positions inside the car and on the platforms. These show that the electric heaters maintain the temperature at from 25 to 30 degrees above that of the outside air, but what it most important, maintain an *even* temperature over the entire car. Thus on a test made on the Atlantic Ave. Railroad, Brooklyn, N. Y., on Feb. 24, on an 18-foot car, the outside temperature for the trip averaged 7 degs. Fahr., while the temperature inside the car averaged 39 degs. Fahr. Only four heaters of the "B" style were employed and the current averaged 5⅓ amperes, which at the average E. M. F. of 436 volts on the line, shows the low consumption of 2,325 watts. On another test with the outside temperature averaging 28 degs. Fahr., the car was maintained at over 55 degs. Fahr. This is a remarkable showing, and indicates the passing of the car stove.

It is claimed by Mr. Silliman, electrical engineer of the Atlantic Avenue Railway Company, that the extra space obtained in their cars by using the American electric heaters more than pays for the extra amount of current consumed to operate them, and that these cars have been plenty warm even in extreme weather. The following are some of the roads using the "American" electric heaters:

Atlantic Avenue Railway Co., Brooklyn, N. Y.; Cincinnati, Newport & Covington Railway Co., Cincinnati, O.; Niagara Falls & Suspension Bridge Street Railway Co., Niagara Falls, N. Y.; Youngstown Street Railway Co., Youngstown, O.; Allentown & Lehigh Valley Traction Co., Allentown, Pa.; Allentown & Bethlehem Rapid Traction Co., Allentown, Pa.; St. Louis & Suburban Electric Railway Co., St. Louis, Mo.; Tonawanda Street Railway Co., Tonawanda, N. Y.; Rochester Street Railway Co., Rochester, N Y.; Rochester Electric Railway Co., Rochester, N. Y.; Norristown Passenger Railway Co., Norristown, Pa.; Paterson Central Railway Co., Paterson, N. J.; Brooklyn City & Newtown Railway Co., Brooklyn, N. Y.; Shenango Street Railway Co., Sharon, Pa.; Lake Rowland Railway Co., Baltimore, Md.; La Fayette Street Railway Co., Lafayette, Ind.; Steinway Railway Co., Long Island City, N. Y.

THE GETTYSBURG ELECTRIC ROAD.

The Gettysburg Electric Railway, which was forced to abandon work on the battlefield last June for want of money, and which was almost in a receiver's hands three weeks ago, has put a gang of men at work in the "Valley of Death" to blast out the rocks just where the operations were interrupted last year. The railway people say the road will now be finished.

CLAIMING THE $50,000 PRIZE.

The Lawrence Electric Co. of New York City has entered a claim to the $50,000 prize offered by the Metropolitan Traction Co. of New York for the best electric system that needs no trolley and is as cheap and efficient as the cable.

THE NASHUA ELECTRIC RAILROAD COMPANY.

The contract for the building and equipping of an electric road of about 100 miles in length, in Brooklyn, N. Y., has just been signed, through the efforts of Mr. William A. Boland of Boston. The road will be known as the Nashua Electric Railroad Company, and its construction will cost about $12,000,000. It is to be built by the Johnstown Rail Company of Johnstown, Pa., and its supplies are to be drawn from the General Electric and Westinghouse companies.

THE TROLLEY IN CHICAGO.

By a very large majority the city council, at its regular meeting on March 5, passed the ordinance giving the Chicago City Railway Company the right to use the overhead trolley system on 22d, 26th, 31st, 39th, 51st, 79th and part of a number of other streets, including Halstead street, south of Archer avenue, Wentworth avenue and Vincennes avenue. The ordinance has met with vigorous opposition from the business men and residents of the neighborhood of those thoroughfares. Mayor Hopkins has not yet decided as to whether he will veto the ordinance or not.

The North Chicago Electric Railway Company ordinance was passed with all the amendments offered by the mayor save the one relating to the single fare from the heart of the city to the terminus of the line.

STREET RAILWAY FINANCIAL ITEMS.

The governors of the Baltimore Stock Exchange have listed $500,000 additional of the first mortgage 5 per cent. 30-year gold bonds of the City and Suburban Railway Company. This makes the issue to date $2,430,000. The total authorized issue is $3,000,000.

The entire issue, $750,500 of 5 per cent. 30-year gold bonds of the Hestonville Passenger Railway Company, principal due May 1, 1924, has been taken by E. B. Smith & Co., bankers of Philadelphia. The issue has been underwritten, but a portion will shortly be offered to the public at 101.

Pittston (Pa.) Street Car Company 6 per cent. bonds to the amount of $200,000 are offered for sale at 103 and interest. The principal and interest are guaranteed unconditionally by the Wilkesbarre and Wyoming Valley Traction Company.

ACTIVITY OF THE JERSEY CITY TRACTION CO.

Jersey City is now practically an electric railway city, almost every inch of the present 52 miles being trollied, while franchises permit tracks for 30 miles more. The Consolidated Traction Co. has spent $1,000,000 on the work. It has about 150 motor cars now in use. Mr. David Young, the active general manager, is getting ready for a fine new power house, of about 1,500 h. p., it is said.

SUCCESS OF THE LIVERPOOL ELECTRIC ELEVATED RAILWAY.

The Liverpool Electric Elevated Railway, which has been in existence about a year, has proved completely successful in operation. It is five miles long, and its total cost, including equipment and all other charge, has been $2,750,000. A five-minute service of trains is maintained with perfect regularity, and so far without mishap of any kind. On a recent holiday 40,000 passengers were carried in eight hours.

WESTINGHOUSE MOTORS FOR THE BOSTON WEST END.

Mr. Samuel Little, the president of the Boston West End Railway gave Mr. Lemuel Bannister, of the Westinghouse Elec. and Mfg. Co., last week, an order for 150 motor car equipments while there is a further order for 50 more should they be needed to meet increase of traffic.

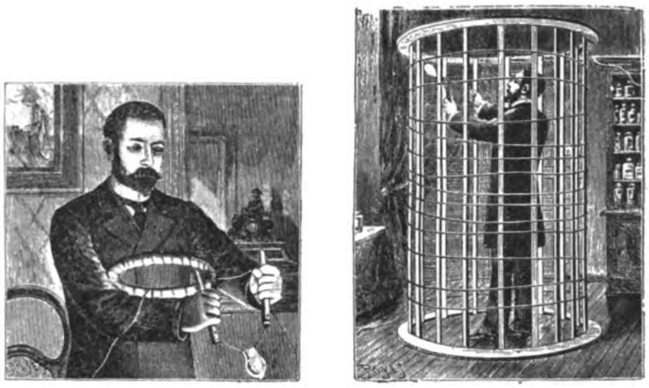
THE TROLLEY ON THE ERIE CANAL.

An investigation is being made by a committee of the New York State Legislature as to the contract recently entered into by Supt. Hannon with the Cataract General Electric Co., discussed in our columns last week.

MISCELLANEOUS.

EXPERIMENTS ON HIGH FREQUENCY CURRENTS BY DR. D'ARSONVAL.

WE have already referred to the experiments of Dr. d'Arsonval with high frequency currents and their physiological effects, and in our issue of August 9, 1893, we described the auto-conduction effects obtained by that celebrated electro-physiologist. M. C. E. Guillaume, in a recent number of *La Nature* describes some further interesting details of these experiments. Among these we find one, illustrated in Fig. 1, in which the operator's arms and body, including in circuit an electric lamp, form the secondary to the coil attached to the high frequency apparatus. The lamp held in the hand in this way lights up without the experimenter being able to feel the slightest shock. Similar results are obtained by the operator placing himself within a solenoid, such as that illustrated in Fig. 2, and grasping the terminals of the lamp.



FIGS. 1 AND 2.—EXPERIMENTS IN AUTO-CONDUCTION.

AN INTERESTING TRANSMISSION PROPOSED IN CALIFORNIA.

WHAT is designed to be the largest transmission scheme yet projected in the west, was brought to light in a recent incorporation at Sacramento, California, of the Clear Lake Electric Company which proposes to transmit 40,000 h. p. from a point near Rumsey, Yolo County, to San Francisco, a distance of 75 miles. As the name of the Company implies, water is to be taken from Cache Creek, the overflow of Clear Lake, at a point near Rumsey, whence it will be taken through three water mains, each six feet in diameter, for a distance of ten miles where a fall of 500 feet will be attained. As stated, this will realize about 40,000 h. p. At present the consumption of power in San Francisco is about 55,000 h. p. and inasmuch as the cost of coal in that city is high, ranging from $6.50 per ton up, it is belived that a ready market will be found for all electric power that may be delivered.

One of the most interesting features in connection with the transmission is the method by which it is proposed to carry the power across the bay of San Francisco. The geography of the country is such that this must be done, otherwise the distance of transmission would be increased to probably 150 miles. It is proposed that the line potential shall be 25,000 or 30,000 volts and that step down transformers shall be placed in a sub-station located at or near the water front of Oakland whence the current will be taken at a materially lower potential across the bay into San Francisco, a distance of eight or ten miles. It has not been determined as yet what this secondary voltage will be. As will be observed, many important details are still very indefinite.

The incorporators of the company are, James Armstrong, President of the Sonora Electric Light Company of Sonora, and President and General Manager of the Pacific Electrical Storage Company; James H. Culver, Secretary of the Mechanics' Institute, San Francisco, Francis X. Simon, of the firm of Palmer & Rey; J. B. Treadwell, capitalist; and Cameron H. King, Attorney, all of San Francisco. The company is capitalized at $5,000,000.

CAMDEN, ME., LOOKING BACKWARD.

THE city of Camden, Me., has taken a long step backward by voting out its arc lights for the coming year, which will leave the streets in entire darkness. The city has also voted to have no night watch. The people are to go to bed at 6 p. m. until further notice, but as the place is a delightful summer resort, it is hoped that the finances may pick up in time for summer trade. Meantime, the beautiful town of Rockport is thinking of putting in arc lights and Thomaston, Me , proposes to increase its plant; so that the "news from Maine" is not altogether one way.

LETTERS TO THE EDITOR.

A BIG OPENING FOR SMALL ARCS.

THERE can be no doubt that the introduction of small arcs on our lighting circuits will be an important step towards the attainment of an ideal method of illumination. Attempts have been made at various times to perfect a system of this kind, but not with any appreciable degree of success. Again, lack of homogeneity in the carbons, and other causes, have made it extremely difficult to run small arcs efficiently, but the comparatively short life of the electrodes has unquestionably been the great barrier to the commercial introduction of small candle power arcs. It is well known that in order to run a small or low candle power arc efficiently, it is necessary to use a carbon of a very small diameter. With such a carbon, of normal length, a life of from six to eight hours may be attained, but this is not sufficient to compete with the incandescent lamp, even though the candle power of the former, per unit of energy consumed, be much greater than that of the latter.

So much for the open-air arc. Now with the enclosed arc, or the "new incandescent arc light" as it has been called, the conditions are very different from those that have heretofore existed. The difficulties that have always stood in the way of the successful application of small arcs are not met with here. I have found it feasible to run arcs of 1½ to 2 amperes and not more than 150 watts—about the same amount of energy consumed by a 50 c. p. incandescent lamp. The life of a pair of electrodes has in some cases been several hundred hours; indeed the life of the negative electrode has exceeded that of the incandescent lamp itself! I need hardly say that results of this character have been found impossible in open air arcs. The inference to be drawn from these facts is clear. The problem of the small arc has been solved and we may look for a speedy introduction of enclosed arcs of one hundred and fifty candle power.

L. E. HOWARD.

NEW YORK, March 23, 1894.

BIG OPENING FOR SMALL ARC LAMPS.

I have read the article on small arc lamps in THE ELECTRICAL ENGINEER of March 14, with much interest. The subject is one, of course, in which I am much interested, and I have given it considerable thought; in fact, as far as I know, I have pioneered the movement in the direction of arcs of low amperage, and the "Bijou" lamps brought out by this company are the first of the kind in commercial use, in this country at least.

Nevertheless I think it is as important to set a limit, below which it is not commercially valuable to go, in the same way as it is, to set the limit in the other direction, as regards amperage. For instance, I do not think that the light from an arc of less than 2 or 2½ amperes would have advantages which would not be overbalanced by the greater convenience of the incandescent lamps of 50 or 100 candle power, or of a cluster of such lamps.

But taking the figures I have named as a starting point, I believe that the lighting of the future will be largely done in this way, and I believe also that it is necessary to still further bring down the size of the arc lamp, and to alter the design so that it shall be more in conformity with the kind of illumination it gives.

S. BERGMANN,
President, General Incandescent Arc Light Co.

NEW YORK, March 21, 1894.

THE DESIGN OF THE MILWAUKEE STATION.

IN your issue of March 14th, there appeared an article on "The Electric Railway and Illuminating Plant of the Milwaukee Street Railway Company," by Otto Frick, and in the same issue an editorial inviting criticism and comment upon any part of the descriptive matter. The writer takes the liberty of making a few remarks relative to the boiler plant and certain statements which are made in reference to the same.

The author states that at the time of adopting these boilers, they were the only ones on the market capable of supplying steam at the high working pressure, which is 160 pounds per square inch. Had the parties in charge of this plant, made even an ordinary investigation of the various boilers in the market at the time this plant was being designed, say three years ago, they would have discovered that the type of boiler which was adopted, was *not* the only one on the market capable of working at the steam pressure above mentioned. They would have found that there were several types of boilers, principally the Stirling, which are specially adapted for high pressures. This company is in a position to manufacture boilers for a working pressure up to 300 pounds if necessary, and for considerably less money per h. p. than the type which has been adopted. Furthermore, it would have been entirely unnecessary, with the use of the Stirling boilers, to have divided the fire room into two floors, as this type of boiler could have been placed, entire, with a slight modification, in the space now occupied by the two fire-rooms and all on one floor, which, to say the least, would have been much more preferable than the present design. The same method of handling the fuel and ashes which has been so excellently arranged, could have been utilized with a considerable reduction in the working mechanism.

FRED'K. A. SCHEFFLER.

NEW YORK, March 22, 1894.

DR. PUPIN ON THE BEHAVIOR OF AIR-CORE TRANSFORMERS.

I NOTICE in your issue of March 21, a note by Messrs. Bedell and Crehore on a paper by E. C. Rimington "On the Behavior of an Air-Core Transformer when the Frequency is Below a Certain Critical Value." I wish to state that I observed the phenomenon experimentally some time ago in the course of an investigation on the harmonic analysis of alternating currents. According to my investigations this phenomenon occurs certainly in all open magnetic circuit iron transformers and is not limited to any critical frequency. I think that I have also observed it in closed magnetic circuits, but in these it is so weak that it appears rather uncertain.

M. I. PUPIN.

COLUMBIA COLLEGE, March 21st, 1894.

WHY PRICES FOR ELECTRICAL STREET LIGHTING ARE REDUCED.

THERE is probably no feature of service that is so great a terror to a central station company as street lighting. If a reasonable price can be obtained for street lighting, most companies can pay interest on their investments, and a small dividend. If, however, they are compelled to take the street lighting contract at a loss, to prevent being raided by some speculative company, or to silence for a time the clamor for a municipal plant, they must bid good-bye to interest and dividends.

Mayors and councilmen, so disposed, invariably seize upon the opportunity offered by a renewal of the public lighting contract to place all sorts of burdens and restrictions upon the company as well as to cut down the price paid for street lighting. It is so easy and cheap to pose as friends of the people in this way, and to get themselves styled as heroes for great courage shown in attacking a monopoly that most men, dependent for their hour of power upon a popular vote, do not have the courage to be just, when to be just would be unpopular.

When a new contract is to be made, an enterprising paper semi-political club, or a person who has been stung by a reform bee, will collect a list of prices from a number of towns, omit every factor showing why a price is lower in one place than in another, or what the tax-payers actually get for their money in any town, and then demand that the price shall be reduced to the lowest on the list.

I have faith in the inherent honesty and sense of justice to be found in the American citizen of average intelligence. I believe if facts are placed before him in a clear-cut way, in a way that he can understand them to be facts, he will not be a party to an unjust act even though the attack is upon a monopoly. It is because no evidence has been at command to show the fallacy of unjust statements, that they are so freely made and have such a disastrous effect through being believed. In attempting to supply this deficiency, the difficulties one has to contend with are enormous, and none more so than the apathy, the want of a cordial response from a large majority of those whom the work is designed most directly to benefit. Managers whose lighting contracts do not expire until next Fall appear not to understand the necessity for making reports *now* to the end that the data may be collected, tabulated, and prepared for presentation so that they may be ready for use at once when wanted.

To illustrate some of these points I will take three examples:

1. A manager was confronted by an unusually low price quoted from a certain town. An enquiry developed the fact that the price was the result of a three-cornered fight between companies seeking street privileges through a public lighting contract, and that the company taking the contract at the low price named was in the hands of a receiver. Men who are just will not ask a company to make such prices.

2. A manager says: "I know the price was cut lower than we ought to go, but we had to take it rather than let the contract go to a competing company who wanted to raid us."

3. Another manager says: "We were confronted by a list of prices from towns all over the country that were lower than ours. We made the best bargain we could on the spot rather than have prices get lower."

In these instances cuts were made from five to fifteen cents per lamp per night.

I have recently made a study to show the deceitfulness of low prices. I selected 79 towns located in eleven States in which all prices are $100 or less per lamp per year. I take into consideration the actual number of hours of service, and the price paid, and calculate the price for 3,000 and for 4,000 hours of service at the rate per hour actually paid. Again I selected 29 towns located in three States in which all prices are over $100 per lamp per year, and calculate the price for 4,000 hours of service at the rate per hour actually paid. The results of these calculations are shown in the following tables:

TOWNS PAYING LESS THAN $100 PER YEAR PER ARC LAMP.

STATE.	Number of Towns.	Number of Lamps.	Average price for 3,000 hours.	Average price for 4,000 hours.
Maine	4	237	$128.10	$170.80
Massachusetts	13	1,086	115.20	153.60
Vermont	3	180	141.00	188.00
Connecticut	9	557	125.10	166.80
New York	7	2,110	90.60	120.80
Pennsylvania	9	2,874	81.60	108.80
Ohio	9	1,382	93.30	124.40
Michigan	8	755	130.50	174.00
Indiana	6	1,324	122.10	162.80
Illinois	6	1,063	123.00	164.00
Wisconsin	5	1.131	114.00	152.00
11 States	79	12,699	$114.93	$153.27

TOWNS PAYING OVER $100 PER YEAR PER LAMP.

STATE.	Number of Towns.	Number of Lamps.	Average price for 4,000 hours.
Massachusetts	14	3,593	$146.00
Connecticut	5	848	146.80
New York	10	5,459	144.80
3 States	29	9,900	$145.87

Is not this illustration sufficient to open the eyes of some managers who have submitted to a cut in prices because they were not prepared to show the fallacy of the claims made against them?

In these 108 towns there are 22,599 arc lamps used for street lighting. *A cut of but one cent per lamp per night means a loss of* $82,486.35. Is not this a sufficient reason to cause every manager to pay a moderate fee per year to secure complete and accurate data, properly analyzed and prepared for presentation to assist him in protecting his price when his present contract expires? Such work is a growth and the more time there is between its initial point and the day it is wanted for use, the greater will be its value when needed. Look at these figures: If a manager can get a council to contract for 4,000 hours service as the average price per hour that is being paid in all towns where the price per lamp per year is $100 or less, he will secure a price that will do him good as long as the contract runs.

The study of prices simply indicates, it does not exhaust, the fallacies of lists of low prices. These tables do not take into consideration the watt-capacity of the lamps, the length of the contract, the protection given by the franchise, the cost of construction, the length of circuits, the cost of fuel, the rates of taxation, nor any of the special burdens placed on companies, such as furnishing free supports for fire alarm wires, free lights for Council Chambers, a license tax on every pole, etc.; when all such details are properly reported by every company I feel perfectly safe in promising any company, at the critical time when it is called upon to renew its public lighting contract, assistance many times the value of all trouble taken by it in making correct reports promptly and of all fees paid to sustain the work of this Association.

THE NATIONAL STATISTICAL ASSOCIATION,
ALLEN R. FOOTE,
Manager.

WASHINGTON, D. C., MARCH 19, 1894.

THE STORAGE BATTERY CHALLENGE.

IN the letter of Mr. Robert McA. Lloyd, published in your issue of March 14, criticising the storage battery challenge of the Electric Storage Battery Company, he stated that "there is something deplorable in the exhibition to which we are invited by the challenge of The Electric Storage Battery Company." There is undoubtedly something very deplorable in this to the manufacturers of the inferior types of battery which have heretofore been making such loud claims to recognition and merit.

Again he states: "The stream of time can be counted on to wash away all the worst fabrics of storage battery development." In this I think he is seriously mistaken. Instead of being washed away, they have multiplied rapidly within the past 14 years since they came into existence, and those to-day having the least merit are making the loudest claims to recognition.

Mr. Lloyd criticises the conditions that Messrs. Houston and Kennelly have proposed, under which the tests should be made. As these do not seem to be satisfactory to him, if he represents any manufacturer of storage batteries who is willing to compete, he may name the conditions under which the competitive test is to be made, and we have no doubt that that the chloride battery will show in such test instead of 50 per cent. at least 100 per cent. greater commercial value than any battery Mr. Lloyd can produce. The challenge is not intended to exclude the zinc-lead batteries, Lelande-Chaperon type or any other type. We will meet any conditions necessary in any particular case.

We are not surprised that various excuses are made, and reasons assigned for not accepting our fair proposition, that will enable the public to obtain reliable information as to the value of the various types of storage battery claiming merit.

W. W. GIBBS,
PRESIDENT, ELECTRIC STORAGE BATTERY CO.

PHILADELPHIA, PA., March 14, 1894.

INFORMATION WANTED ON INCANDESCENT ARCS.

WILL someone conversant with "incandescent-arc" lamps please enlighten me on the following points:

In the ordinary arc lamp, where the carbon points are exposed to the atmosphere, I have always understood that the incandescence of the carbon particles detached from the positive carbon aided materially in producing a bright light. In the "incandescent arcs," where the destruction of the carbons is so slow, and there is little carbon vapor, does the same length of arc produce an equivalent amount of light? Also, the carbon vapor being a semi-conductor, is not a greater E. M. F. required to maintain a given length of arc in the closed lamp, where it is (practically) absent than in an open lamp where the vapor is present? R. W.

WASHINGTON, D. C.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—SIMULTANEOUS MEETINGS IN NEW YORK AND CHICAGO.

The 84th meeting of the Institute was held at 12 West 31st St., New York City, March 21st. A paper "On the Effect of Heavy Gases in the Chamber of an Incandescent Lamp," was presented by Prof. W. A. Anthony of Vineland, N. J., Past-President of the Institute. The discussion was opened by Prof. Wm. Lispenard Robb of Trinity College, Hartford, Conn. A meeting of the Chicago members was also held simultaneously, at which the same paper was read and discussed at the Armour Institute. The author was represented at Chicago by Prof. Dugald C. Jackson of Madison, Wis. Through the courtesy of the Metropolitan Telephone and Telegraph Co., of New York, the American Telephone and Telegraph Co., and the Chicago Telephone Co., telephonic communication was established between the two meetings, with Mr. A. S. Hibbard at the Chicago terminal and Mr. J. J. Carty in charge of the arrangements in New York. Both gentlemen are members of the Council of the Institute. The possibility of bringing distant audiences in touch with the author of a paper, was satisfactorily established, and before adjournment, President Houston, at New York, spoke over the wire to attentive listeners in both cities extending congratulations upon the success of the dual meeting, and informing the Chicago members that the report of the Committee on Units and Standards had been approved recommending the provisional adoption of the term "gilbert" for the C. G. S. unit of magneto-motive force, the "weber" for the C. G. S. unit of magnetic flux, the "oersted" for the C. G. S. unit of reluctance and the "gauss" for the unit of flux density. About 80 members and guests were present at the New York Meeting, and 40 in Chicago. The Chicago meeting was presided over by Mr. Angus Hibbard, who is a member of the Council of the Institute.

At the Council meeting in the afternoon, the following Associate Members were elected:—

Cornelius R. Agnew, Electrical Engineer, Kinsman Block System Co., 28 West 39th St., New York City; C. O. C. Billberg, Electrical Engineer, Thomas H. Dallett & Co., 3200 Arch St., Philadelphia, Pa.; William L. Bliss, B. S., M. M. E., Electrical Engineer, Riker Electric Motor Co., 24 Irving Place, Brooklyn, N. Y.; E. R. Carichoff, Electrical Engineer, Sprague Electric Elevator Co., 126 West 34th St., New York City; Herbert B. Coho, Engineer, Waddell-Entz Co., 203 Broadway, New York City; J. Fred. Galletly, Electrician, Swift & Co., Chicago, Ill.; Henry Jackson, Telegraph Supt. and Engineer, The Lancashire & Yorkshire Railway Co., Horwich, Bolton-le-Moors, Lancashire, England; Edwin R. Keller, 4828 Springfield Ave., Philadelphia, Pa.; John W. Kirkland, Electrical Engineer, General Electric Co., Schenectady, N. Y.; Leo A. Phillips, Westinghouse Electric and Mfg. Co., 98 Green St., Newark, N. J.; William F. B. Rouquette, Proprietor, Rouquette & Co., 12 Wooster St., New York City; Henry A. Rowland, Professor of Physics, Johns Hopkins University, Baltimore, Md.; J. Brodie Smith, Supt. and Electrician, Manchester Electric Light Co., 142 Merrimack St., Manchester, N. H.; Dr. Ernst Voit, Professor of Electricity, Technical University, Schwanthalerstrasse, München, Germany.

The following Associate Members were transferred to Full Membership upon recommendation of the Board of Examiners:—

Geo. H. Almon, Agent, Belknap Motor Co. and L. P. & D. Transmitter Co., Boston, Mass.; Ernst Egger, Electrical Engineer, Vienna, Austria,; W. H. Brenner, Electrical Engineer, Montreal Street Railway Co., Montreal, P. Q.; Clark C. Haskins, City Electric Light Inspector, Chicago, Ill.; James S. Fitzmaurice, Chief Engineer Electric Light Branch, Sydney, N. S. W. Total 5.

Upon recommendation of the Sub-Committee on Papers and Meetings, it was voted to hold the Annual and General Meetings of the Institute in Philadelphia, May 15th and 16th.

As required by the Rules the Council also canvassed the nominations received from the membership during the month of February, and prepared the following ticket for the coming election, ballots for which will be issued in April:—For *President*, Professor Edwin J. Houston; for *Vice-Presidents*, Professor Wm. A. Anthony, Professor Francis B. Crocker, and Mr. James Hamblet; for *Managers*, Messrs. A. E. Kennelly, W. D. Weaver, Chas. S. Bradley and William B. Vansize; for *Treasurer*, Mr. George M. Phelps.

PROF. HOUSTON ON "THE FUTURE OF ELECTRICITY."

Prof. Edwin J. Houston delivered an address before the Young Men's Christian Association, Philadelphia, on Thursday evening March 22, taking for his subject "The Future of Electricity."

In assuming the role of a prophet, he said, one must needs be on one's guard. So many marvelous achievements have been recently wrought in electrical science that the world has grown credulous and much is required to astonish it. This fact renders the labors of the prophet both easier and more dangerous; easier, because no matter how rash his predictions, or how far he may endeavor to peer into the future, he is apt to find a ready belief in his predictions; more dangerous because this very credulity may tempt him to overstep the limits of probability.

The speaker then referred to a number of incidents illustrating the rapid changes wrought through the energy of electricity in our own time. He spoke of the work at Neversink Mountain where the current is generated down below in the valley and carries light and power to the top. Thales, he said, discovered the true Alladin's lamp in the year 500 B. C. The speaker then told a number of amusing anecdotes appropos of the subject in hand and quoted passages from Oliver Wendell Holmes' "Broomstick Train." He then quoted an article by himself published in *McClure's Magazine* for January, 1894, and recently reprinted in these columns, embodying his views upon the immediate future of electrical science and industry. He did not think that much improvement would be made along lines with which we are now well acquainted, agreeing in this respect with Prof. Elihu Thomson. There was, however, he added, a marked possibility for improvement for the production of artificial light, unaccompanied by heat. If the future could produce light without sensible heat, the present forms of electric lighting would of necessity become uncommercial and inoperative, since the proportion of light emitted under the most favorable circumstances was but two or three per cent. while the proportion of heat was from 97 to 98 per cent.

The near future may look presumably for the replacing of large arc lights by small ones. As regards a new method for the production of electricity directly from the burning of coal the signs of the times would appear to point to its early realization. The problem would appear to be to produce electricity directly from the oxidation or burning of coal instead of first burning the coal to drive a steam engine, which in its turn drives a dynamo. Along the lines of such improvements even a comparatively inefficient method would prove far more practicable than the old method, since the best steam engine does not give as high as 18 per cent. efficiency, while another loss, small though it be, occurs during the conversion of the mechanical into electrical energy. The speaker referred to Mr. Tesla's experiments and quoted his statements that we should shortly have at hand the means to produce twice as much electricity from coal as is at present possible.

From this point the lecture dealt with the electrical transmission of power and the speaker gave some popular statistics of long distance transmission from the Lauffen-Frankfort experiments to the recent work at Niagara Falls.

LEGAL NOTES.

THE EDISON SOCKET PATENT DECLARED EXPIRED.—EDISON ELECTRIC LIGHT CO. vs. THE ELECTRIC ENGINEERING AND SUPPLY CO.

Judge Coxe sitting in the U. S. Circuit Court for the Northern District of New York has handed down a decision in the suit brought by the Edison Electric Light Co. against the Electric Engineering and Supply Co., of Syracuse. The suit involved the consideration of five patents all relating to improvements in sockets for incandescent lamps.

The most important of these is that of T. A. Edison, No. 265,311, Oct. 3, 1882. The 2nd and 3d claims of which were involved, as follows:

> 2. A socket for an electric lamp, adapted to be placed upon a gas-pipe or other suitable support, and provided with contact-plates forming the terminals of an electric circuit, and arranged substantially as set forth.
>
> 3. A socket for an electric lamp, adapted to be placed upon a gas-pipe or other suitable support, and provided with contact-plates forming the terminals of an electric circuit, and also provided with a circuit-controller inserted in one branch of the circuit for controlling the circuit, substantially as set forth.

After a thorough discussion of the arguments the Court holds that the patent is valid but that it expired Dec. 14, 1891, in virtue of the expiration of the Russian patent granted Dec. 14, 1881, for 10 years. Owing to the fact that suit was brought two months before the expiration of the patent an accounting is granted.

The second patent issued to E. H. Johnson, No. 251,596 Dec. 27, 1881, for an improvement in sockets and holders, next discussed by the Court, has heretofore been held to be the broad patent covering all sockets that have *exterior metal shells*. The fifth claim only was involved, as follows:

> 5. In a socket for electric lamps, the combination, with interior insulating portions provided with circuit-connections, of exterior metal portions, forming a covering therefor, substantially as set forth.

Reading the claims in connection with the specification the Court says:

> I think it must be held invalid for lack of patentability. One who covered the interior insulating portions of an electric light socket with such a case would infringe the claim without reference to the manner in which the terminals of the wires were connected to the binding posts. To provide such a case in view of all the prior knowledge on the subject did not involve invention. The socket looked better, but the case added no new function; the old parts operated in the old way. Mr. Johnson has very likely made an ingenious and patentable improvement, but the difficulty is that the claim in controversy is not aptly to cover such improvement.

The patent of Sigmund Bergmann, No. 257,277, May 2, 1882, covering sockets of the Edison type, was sustained. The second claim only was involved, as follows:

> 2. In an electric socket, the combination, with the body of insulating material, of a plate in the bottom of the socket, and a horizontal screw ring located between the bottom plate and the mouth of the socket, said plate and ring engaging opposite parts on an entering base or plug, and serving to compress the base or plug between the terminals carried by it, substantially as set forth.

Patent No. 298,658, May 13, 1884, to S. Bergmann, was withdrawn from the consideratien of the court during argument; and in the case of claims 4 and 6 of No. 293,552, Feb. 12, 1884 to the same inventor, infringement was admitted and an injunction and accounting granted as well as in the case of the patent No. 257,277, but without costs.

C. E. Mitchell and R. N. Dyer for complainants and Alfred Wilkinson for defendants.

PHONOGRAPH TROUBLES.

AN application has been made to the Court of Chancery, Newark, N. J., by Thomas A. Edison and Col. E. Gouraud for the appointment of a receiver for the Edison United Phonograph Company, on the ground that it is an insolvent corporation. The bill claims that the directors of the company have pursued a policy contrary to the views of the holders of one-half of the company's stock, which has resulted in the wasteful and injurious operation of the company, and caused its insolvency. It adds that the arrangement between the parties constitutes a trust to carry on the business in a way to be approved by the company, and prays that the trust be assumed by the court and a receiver appointed to carry on the business and investigate the condition of affairs so that the company may be wound up. The bill will be answered on March 29.

MINNEAPOLIS, MINN. The city has won the suit brought by the President of the city council against the city and the Brush Company to procure the cancellation of the five years' contract made in August 1892, between the city and the company for city lighting. Judges Smith, Hicks and Elliott filed their decision March 6, declaring the contract invalid, as the city had no right under its charter, to incur debts or liabilities that cannot be paid out of the funds actually levied for and applicable to such payments.

LITERATURE.

A Textbook of Electro-Magnetism and the Construction of Dynamos. Vol. I. By Dugald C. Jackson, B.S., C.E., Professor of Electrical Engineering in the University of Wisconsin. New York. Macmillan & Company, 1893. 281 pp. 5 x 7½ inches. Price, $2.25. Illustrated.

THIS book has been written especially for the class-room, and as such, contains much that would otherwise be omitted from a general work on the subject, while, on the other hand, it does not contain what would be found in a work intended for more general reading. Thus, for instance, we find practically no descriptions of dynamos, which have so often been described, and which it is actually a relief to find missing from a book of this kind. What the author has done is to try to impress upon the student, first, the meaning of the terms and quantities with which he has to work in the design of dynamo machinery, and then passing on to the treatment of the simple electro magnet and the magnetic properties of iron. In these sections are described the most approved methods of determining the qualities of iron, and many useful curves are given showing the effect of various degrees of magnetization and of the impurities in iron and steel.

The author then takes up the subject of electric pressure and its establishment in a magnetic field, beginning with the ideal slider and leading up to the conductor as wound upon the armature, of which several actual examples are given. In the chapter devoted to the magnetic circuit of the dynamo, the leakage, reluctance, influence of pole pieces, etc., are taken up, and in the succeeding chapter the author has elaborated to a considerable degree this latter development in dynamo construction, viz., the compensation for cross magnetization and the effect of brush contact. He has here introduced very properly the latest method of compensating for the effect of cross magnetization due to Professor H. J. Ryan, and the latest device of Sayers for preventing sparking. Characteristic curves, regulation and efficiencies are treated of in separate chapters, which are accompanied by numerous curves and diagrams illustrative of the text. A final short chapter is also devoted to multipolar dynamos.

As it is the author's object to bring home to the student the theory and fundamental principles, he occasionally assumes conditions which are probably scarcely ever met with in practice, but it would be unfair to criticise this treatment of the subject in a work ostensibly intended only as a text book. After all, whether it be in electricity or any other branch, the thorough and complete undertanding of the fundamental laws and theories is the prime object to be striven for in the class room. Once these are thoroughly understood, there application to actual machines, of which there are so many already in existence to guide one in the design, is a simple matter. The work as a whole is a very concise presentation of the subject and can be studied with much profit by all who are pursuing a course in dynamo design.

The Electrician Electrical Trades Directory and Hand Book, for 1894. Twelfth year. London, 1894. The Electrician Printing & Publishing Company. 846 pp. + CXXXI.

Besides the usual Index to British, Colonial, Continental and American electrical firms and individuals engaged in electrical work, the directory, as in previous years, contains a vast amount of miscellaneous information, the latest standard rules, Board of Trade regulations and various data on the safe carrying capacities of wires, etc. We also find a complete list of central lighting stations of the United Kingdom, including those at work and projected. The biographical section contains sketches of the careers of no less than 262 prominent electrical engineers and others identified with electrical science. The Directory has been very carefully revised and is well up to date.

OBITUARY.

PHILIP HERZOG.

Philip Herzog, an old friend of Kossuth and a resident of this city, died last week at his home, 45 East Thirty-first Street. Mr. Herzog was in his sixty-ninth year. He was born in Hungary. In 1850 he fled to this country with other refugees of the Hungarian revolution. When Kossuth came over and was given a reception in this city it was Mr. Herzog who introduced him. Mr. Herzog was made one of the Appraisers of this port under Lincoln. He was an ardent Republican. For some time Mr. Herzog had been treasurer of the Herzog Teleseme Company, at 30 Broad Street, formed to introduce the highly ingenious inventions of his son, Dr. F. Benedict Herzog.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 13, 1894.

Accumulators :—

Secondary Battery, E. R. Whitney, Manchester, N. H., 516,258. Filed Feb. 4, 1893.

Consists of a number of insulating trays placed one above the other and having positive and negative plates supported on their inner and outer surfaces and joined by connectors passing through the trays.

Switch for Secondary Batteries, H. Muller, Nuremberg, Germany, 516,379. Filed Dec. 27, 1892.

Employs two sliding contacts and two separated guide-ways composed of contact pieces alternating with isolated pieces of metal, and a resistance with which the isolated pieces are connected.

Alarms and Signals :—

Electrical Protection for Safes, C. F. A. Sturts, San Francisco, Cal., 516,239. Filed Apl. 11, 1893.

Electrical Protection for Windows, C. F. A. Sturts, San Francisco, Cal., 516,240. Filed Apl. 11, 1893.

Electromechanical Gong, M. Martin, Malden, Mass., 516,500. Filed Aug. 8, 1893.

Automatic Block Signal, J. D. Taylor, Chillicothe, O., 516,558. Filed May 29, 1893.

An automatic semaphore system for steam railways.

Electric Railway Signal, I. L. Green, Kittanning, Pa., 516,596. Filed July 22, 1893.

An automatic electric block system for steam railways.

Semaphore Signal, I. L. Green, Kittanning, Pa., 516,597. Filed July 22, 1893.

Electrical Railway Signal, I. L. Green, Kittanning, Pa., 516,598. Filed July 28, 1893.

Conductors, Conduits, and Insulators :—

Cable-Hanger, A. E. Johnson, Wakefield, Mass., 516,205. Filed July 6, 1893.

A metallic strap surrounding the cable and provided with a tongue and lock for suspension.

Dynamos and Motors :—

Alternating Current Motor, R. Lundell, Brooklyn, N. Y., 516,213. Filed July 30, 1892.

Employs a pair of stationary inducing field coils and a movable armature provided with a series of coils having their free ends attached to a current collecting device, and fixed and movable pairs of brushes connected by shunt circuits.

Electric Motor, O. F. Conklin, Dayton, O., 516,268. Filed Jan. 9, 1893.

Employs a field magnet with two sets of coils enclosed by the armature, and a vertical rod with a cam loosely mounted thereon for making connection with one or both coils.

Dynamo Electric Machine, F. J. Crouch, Portland, Ore., 516,298. Filed Feb. 27, 1893.

Employs separable fields having flanged ends removably connected and means for vertically adjusting the connected fields within the base frame.

Commutator for Electric Machines, C. Olivetti, Ivrea, Italy, 516,447. Filed Apl. 29, 1893.

A commutator divided into a number of electrically separated parts each consisting of a series of segments alternating with broad insulating spaces, and brushes for each separate part of the commutator so arranged that the brushes of the same polarity shall have successive and continual action.

Electric Current Regulator, C. D. Haskins, Brooklyn, N. Y., 516,487, Filed Apl. 1, 1889.

Claim 1 follows:

The combination with a source of electricity, of a working circuit connected therewith, a regulator for controlling said working circuit, a frictional device to operate said regulator and an electric motor to actuate the frictional device.

System of Car Lighting, Heating, &c., I. N. Lewis, Fort Wadsworth, N. Y., 516,495 Filed July 15, 1893.

Claim 1 follows:

In a railway car carried by a swiveling truck, the combination with a dynamo, power driven from the axle of said truck, of a power transmitting shaft carried by an arm or bracket mounted on the equalizing bars of the truck.

Car Lighting, I. N. Lewis, Fort Wadsworth, N. Y., 516,496. Filed Sept. 6, 1893.

Employs a storage battery and a self regulating dynamo feeding the battery and having a field exciting coil fed from the battery and an opposing field coil in the main circuit with the armature.

Self Regulating Dynamo, I. N. Lewis, Fort Wadsworth, N. Y., 516,497. Filed Sept. 6, 1893.

Regulation consists in increasing the strength of current with an increase of speed and by such increased current cutting down the increment of voltage which would arise from the increased speed of rotation of the armature. (See The Electrical Engineer, March 14, 1894.)

Electric Motor for Street Cars, W. Baxter, Jr., Baltimore, Md., 516,516. Filed Apl. 4, 1891.

A motor having the armature concentrically mounted upon the car axle and a field divided into two parts arranged on opposite sides of the vertical diameter of the armature; the upper and lower poles lying in substantially horizontal planes between which the entire machine is included.

Suspended Electric Fan Motor, J. F. Denison, New Haven, Conn., 516,524. Filed Jan. 9, 1893.

Armature for Dynamo Electric Machines or Motors, W. B. Sayers, Glenwood, Bearsden, Scotland, 516,553. Filed Apl. 26, 1892.

The sections of the windings are connected to the commutator strips by coils so wound upon the armature core that the current generated in each of them and the adjacent armature section will be in the same direction.

Heating :—

Automatic Heat Regulating Apparatus, C. F. Goodhue, Boston, Mass., 516,198. Filed May 11, 1893.

An electric apparatus automatically operating dampers in the furnace.

Electric Heater, J. O'Meara, New York, 516,506. Filed Dec. 22, 1892.

A portable electric heater having a casing with lateral flanges and a series of changeable tops fitting upon said flanges and varying the extent of the upper surface of the heater.

Lamps and Appurtenances :—

Regulating Socket for Incandescent Lamps, M. D. Greengard, St. Louis, Mo., 516,484. Filed May 18, 1893.

Employs a resistance in the socket of the lamp and a revoluble shaft with contacts for cutting in more or less resistance as desired.

Electric Arc Lamp, F. L. McGahan, Indianapolis, Ind., 516,574. Filed Jan. 2, 1892.

Claim 1 follows :—

In an electric arc lamp the combination of a casing, a spiral carbon magazine, with springs therein for forcing the carbons to the centre of the same, an opening in line with such centre through which the carbons are adapted to pass, spring arms for holding such carbons, means for feeding the same, and circuit wires connected to such spring arms.

Measurement :—

Safety Device for Electrostatic Measuring Instruments, W. E. Ayrton and T. Mather, London, Eng., 516,341. Filed Sept. 7, 1893.

Claim 1 follows:—

In combination in an electrostatic measuring instrument a "safety terminal" having the metal parts inclosed in insulating material, safety fuse holder and short-circuiting device.

Metal Working :—

Process of Electric Metal Working, H. Lemp, Lynn, Mass., and W. S. Moody, Chelsea, Mass., 516,312. Filed Oct. 20, 1890.

Employs an intermediate terminal making connection with the work placed between the two opposing terminals.

Miscellaneous :—

Magnetizing Coil, J. D. Ihlder, Yonkers, N. Y., 516,204. Filed Nov. 18, 1892.

Employs a double magnetizing circuit whose parts are in shunt relations to each other and wound in opposite directions.

Electric Perforating Pen, A. D. Lewis, Canton, Mo., 516,212. Filed July 15, 1893.

Electric Lock, J. R. Donnelly, Fairfield, Me., 516,478. Filed Mch. 30, 1893.

Adapted especially to money drawers, etc.

Process of Coating Cast-Iron With Other Metals or Alloys, L. R. Nourse, Elgin, Ill., 516,551. Filed July 12, 1893.

Design for a Transmitter-Dial, C. F. Scattergood, Albany, N. Y., 23,111. Filed Dec. 28, 1893.

Design for a Dial for Electrical Annunciators, C. F. Scattergood, Albany, N. Y., 23,112. Filed Dec. 28, 1893.

Railways and Appliances :—

Electric Railway, M. W. Dewey, Syracuse, N. Y., 516,188. Filed July 6, 1889.

Employs a traveling primary coil in electric connection with the line conductor moving in the vicinity of the car carrying a secondary coil; the former running in a conduit and being drawn along by magnetic attraction.

Car Lighting, W. M. Miner, Plainfield, N. J., 516,336. Filed Nov. 7, 1893.

Employs a storage battery in series with the lamps and means controlled by the current for breaking and making the connection between the battery and one or more substitute lamps.

Closed Conduit Electric Railway, F. L. King, Chicago, Ill., 516,374. Filed May, 5, 1893.

Employs a conduit with a flexible cover and armatures arranged upon the cover acting in conjunction with magnets carried by the car.

Electric Trolley Device, C. Knapp, St. Louis, Mo., 516,492. Filed Nov. 20, 1893.

Employs a fork swiveled at the end of the trolley pole and a spring slightly resisting any tendency to deflection.

Electric Railway Supply System, J. F. Cummings, Detroit, Mich., 516,565. Filed Sept. 22, 1892.

Employs two distributing conductors and a contact device having rotary travelers arranged horizontally; the slot being provided with elastic flaps adapted to fold over the opening when the car is not passing.

Closed Circuit Electric Railway, E. H. Brown, Salem, Mass., 516,626. Filed Apl. 22, 1893.

Employs closed independent and separate sections of conduit each forming a surface conductor, a section of a continuous central rail, and an insulating inclosure, in combination with independent longitudinal switch contacts each lying loosely within such inclosure.

Closed Conduit for Electric Railways, W. Lawrence, New York, 516,631. Filed May 2, 1893.

Claim.—In a system of electric distribution, a main conductor, a contact, a connection from the main conductor to the fixed part of said contact, a sectional working conductor, a rod connecting the moving conductor with the weighted lever, and a water tight casing inclosing the contacts and lever.

Switches and Cut-Outs :—

Rheostat, H. McNulta, Bloomington, Ill., 516,217. Filed May 1, 1893.

Claim 1 follows:

In an electrical resistance the combination with a series of plates, each of said plates having projections adapted to lie in contact with an adjacent plate, of means for binding said plates together.

Electric Switch, I. N. Lewis, Fort Wadsworth, N. Y., 516,498. Filed Oct. 12, 1893.

The invention consists in the combination with a dynamo having a regulating coil which cuts down the field upon increase of speed, of a pole changer between the coil and the armature and a polarized controlling magnet or armature for said pole changer responsive to reversals of the direction of armature rotation.

Telegraphs :—

Telegraph Apparatus, J. A. Parker, St. Louis, Mo., and L. L. Summers, Chicago, Ill., 516,552. Filed Feb. 23, 1893.

Employs a series of revolving contacts adapted to send characters over the line, depression keys operating the contacts and means for bringing the keys and contacts into co-operation upon either a successive or a simultaneous depression of the keys.

Telephones and Apparatus :—

Interior Telephone System, T. McCoubray, New York, 516,506. Filed Dec. 4, 1893.

Employs a series of keys all permanently connected with one pole of the battery, a series of signaling receiving instruments, a series of normally open contacts, and electrical connection between the contacts and the receiving instruments and the other pole of the battery.

The Non-Arcing Metal Lightning Arrester, for alternating current circuits, has created an urgent demand for a similarly efficient and reliable lightning arrester suitable for street railway and other direct current circuits.

The Westinghouse Company are, therefore, now introducing the Wurts non-arcing railway lightning arrester, which not only equals the non-arcing metal arrester in its efficiency and reliability, but even surpasses it in point of simplicity. This arrester has been thoroughly tested during the past season in frequent and violent thunder-storms, and in every instance has, it is said, proved all that is claimed for it.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE GIBBS ELECTRIC COMPANY'S NEW MULTI-POLAR APPARATUS.

THAT the design and manufacture of electric light and power apparatus has been reduced to a purely commercial basis, will hardly be denied by any one who has taken the trouble to follow the development of this modern industry. A striking example of close application of well-known mechanical principles, coupled with scientific methods of electrical design, is to be found in the apparatus of the Gibbs Electric Co., illustrated herewith, and now being manufactured in any desired size at the company's works at Milwaukee, Wis.

In designing the entire machine the salient features considered were: 1. The elimination of all hand labor wherever possible, and the substitution of machine work therefor. 2. Perfect interchangeability of all parts. 3. Highest possible efficiency, consistent with economical design. 4. Durability of all parts in the highest degree.

As one of the means of arriving at the above results, the frame of the machine is built in but two parts, consisting of a circular yoke, with four integral, inwardly projecting pole pieces, the front or commutator end bearing arm being also cast integral with the frame, Fig. 1. To allow of removal of the armature, the rear bearing arm is fastened to the yoke by four bolts, the joints being rabbeted, so as to secure absolute alignment of the armature shaft. The absence of all magnetic joints in the field frame undoubtedly adds in no slight degree to the efficiency of the machine.

This construction is carried out in all sizes below 8 K. W. On the larger sizes, where the weight of the armature is too great to admit of "end removal," the frame is split on a horizontal line and bolted together, the general appearance of the machine however remaining the same.

In the bearing arms are inserted false boxes, which carry the bearings proper. The latter are of the usual ball and socket type and made self-oiling by means of rings. Quite a neat arrangement is used to show at all times the height of oil in the reservoir, the vision glass being almost flush with the journal, thereby lessening materially the liability to damage. The bearing arms themselves, by virtue of their shape, provide a substantial protection to the machine against mechanical injury, in addition to their purely utilitarian value.

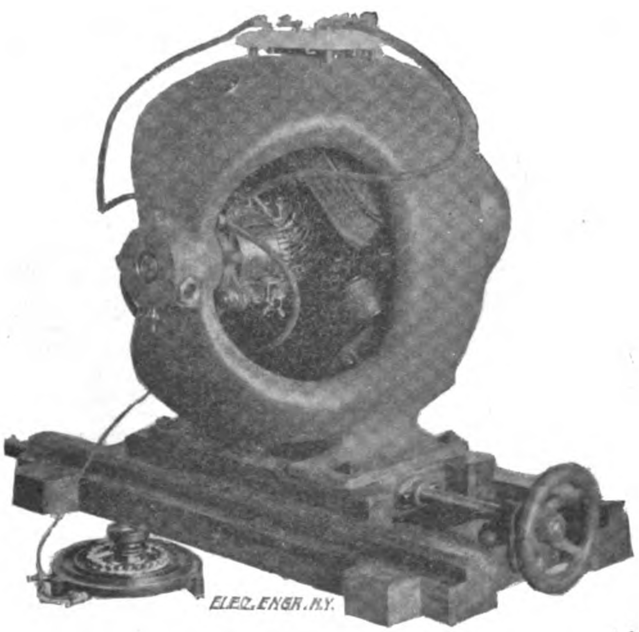

ELEC. ENGR. N.Y.

FIG. 1.—THE GIBBS MULTIPOLAR GENERATOR.

The construction of the armature is well shown in the illustration, Fig. 2. In its design the inventors have gone out of the beaten path of the well known Siemens and Gramme windings and produced a winding which possesses several new features. It is a modified form of drum winding for multipolar machines and of such shape, that the coils can be entirely machine wound, leaving the form of the exact shape as shown in place on the armature core. The result is, that the coils at no time are subjected to any mechanical stress, such as hammering or stretching. After being wound on a former, properly insulated and baked, they are placed in the armature grooves and secured in place by the usual binding bands. In view of this peculiar construction, *i. e.*, the absence of any mechanical straining or change of form of the coils, the life of the armature is increased to a great extent. Another important advantage gained consists in the coils being necessarily of the same length; absolute electrical balance of the machine is thus assured and to this fact is partly due the immunity from sparking at the brushes.

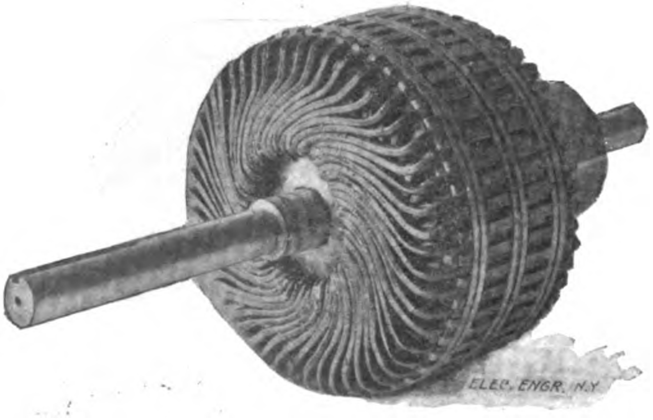

ELEC. ENGR. N.Y.

FIG. 2.—THE GIBBS ARMATURE.

Brush holders of a novel form are provided, carrying end-on carbon brushes, the spring pressure being equalized between the two brushes, assuring equal wear on the commutator. A feature which will appeal to the user of such machines is, that there is no rocker arm provided to shift the position of the brushes. They are fixed rigidly at the non-sparking point and the design of the machine is such that there is no noticeable sparking under any condition of load. This practically reduces the required attention to the machine to occasionally changing the oil in the journals, and keeping the commutator clean.

The following data of one of the Gibbs dynamos may be of interest:

Output in K. W., 13; speed in revs. per min., 900; floor space over all, in inches, 25 x 29 x 29; total weight in lbs., 885; peripheral speed of armature, feet per sec., 53.4; res. of armature, .0298 ohm; res. of shunt field at 60° Fahr., 43.4 ohms; res. of compound coils at 60° Fahr., .00845 ohm; temperature increase of armature core under full load, 31° Fahr.; temperature increase of armature conductors under full load, 35° Fahr.; temperature increase of magnet cores, 41° Fahr.; electrical efficiency, 92.5 per cent.

ELECTRICAL APPARATUS FOR THE PITTSBURGH REDUCTION CO. AT NIAGARA.

THE GENERAL ELECTRIC COMPANY has just closed a contract with the Cataract Construction Company for the furnishing of about 2,000 H. P. of apparatus to be used in the plant of the Pittsburgh Reduction Co., at Niagara Falls. The apparatus in question is intended to transform the two-phase current delivered from the station of the Cataract Co. at 2,500 volts into continuous current at 160 volts for the use of the Reduction Co. The plant of the Pittsburgh Reduction Co. is located about 2,500 feet from the power station.

There will be furnished eight 200 k. w. step-down transformers and four 370 k. w. revolving transformers, for transforming two-phase current into continuous current. It is believed that this will be the largest plant of the kind in the world, and the installation will mark an interesting step in the development of the use of multiphase currents for transmission purposes being again transformed into direct currents at the point of utilization. In addition to the apparatus above mentioned the General Company also furnishes the necessary switch board and appliances.

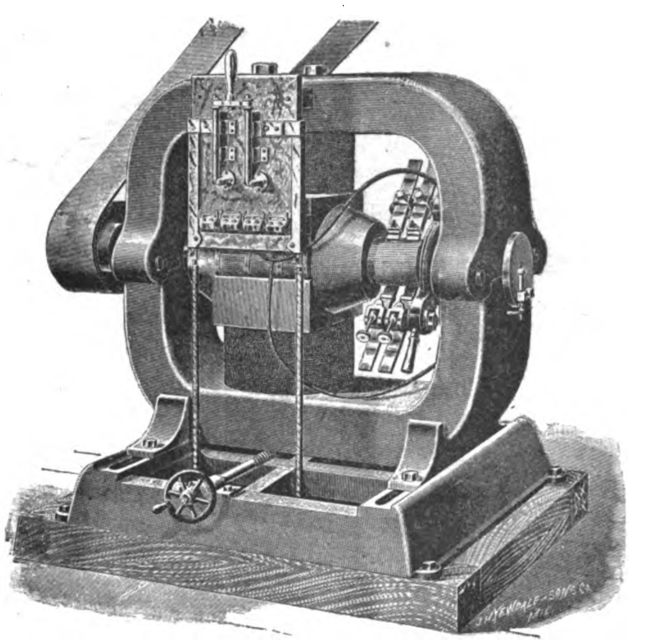
THE RISDON IRON AND LOCOMOTIVE WORKS, of San Francisco, Cal., have received the following letter from one of their customers, the President of the Union Ice Co., to whom they furnished some Schieren belts last summer.

> "The two double Perforated Electric Leather Belts I purchased of you last summer for the Union Ice Co. factory, Mentone, San Bernardino Co., Cal., are doing splendidly. The 20'' belt on 26'' motor pulley has a velocity of about 5,000 feet per minute. The 30'' belt has a velocity of about 3,000 feet per minute. Each transmits 1,500 h. p. and are as perfect as when first put on."

NEW DYNAMO OF THE JOHNSON ELECTRIC SERVICE CO.

THE JOHNSON Electric Service Co., of Milwaukee, Wis., well-known as among the pioneers in automatic electric ventilation have just brought out a dynamo machine which is illustrated in the accompanying engraving.

The machine which was designed by Prof. D. C. Jackson, Professor of Electrical Engineering at the University of Wisconsin, has fields of the box type, and the armature shaft is supported in the neutral point of the frame, giving great mechanical stability to the machine. The metal of the fields is of such character, mass, and distribution that the desired magnetic lines are secured with the least expenditure of energy. There is practically no magnetism shown externally, except at the pole pieces. The shaft is of the best steel and the core of very thin and insulated laminations. The boxes are of phosphor-bronze, self-aligning and self-oiling, so that the machines require oiling no oftener than from two to four weeks; in the mean time the bearings remain perfectly cool. The commutator is of the best copper, and the holders have an excellent spring action and adjustment. The switches are on the machine, and are supported on a marble slab.



THE JOHNSON ELECTRIC SERVICE CO.'S DYNAMO.

As shown in the engraving, the upper field is hinged to the lower at the neutral point by ample contact. When it is desired to remove the armature, the upper field is tipped toward the switch side, which opens up the field and exposes the boxes and armature drum. It will also be noticed that the fields are movable by means of a belt-tightener on a solid cast iron base. The Johnson Co., is equipped to build these machines in all sizes.

THE ATTRACTIVE CATALOGUE OF THE ELECTRIC APPLIANCE COMPANY.

THE ELECTRIC APPLIANCE COMPANY, Chicago, have issued a great many of their Number Six catalogue, the latest edition of their complete catalogue of electrical supplies. It is a handsome and valuable book. A special effort has been made to secure a catalogue that would be as compact and concise as possible, omitting all worthless or superfluous cuts and descriptive matter, without omitting a single detail necessary to make the catalogue complete in every respect. One customer who evidently appreciates this effort writes as follows: "Your latest catalogue received and we think it is the best one ever gotten out for everyday use, full of latest appliances and omitting a lot of trash, so often contained in others, which, as a rule, have but one object—to add thickness, length and width to the book."

But to turn to a description of the book itself. It is bound in heavy purple "Princess" covers with lettering on two sides and back in fire bronze. The title page bears in red the Electric Appliance Company's well-known triangle trade mark. The first principal division of its contents is incandescent electric light supplies, which starts out with an extended list and description of Packard lamps, follows with a complete list of cut-outs, sockets, etc., and closes with a very complete and handsome line of electric and combination fixtures and shades. Arc light and station supplies form the next principal division with an extensive line of goods for station use and arc lighting, including carbons, globes, spark arresters, etc.

A complete and well illustrated list of construction and general tools follows and is immediately followed by a very carefully selected line of construction material including extensive lists of Paranite rubber covered and "O. K." weatherproof wire—two leading specialties. Immediately following the lists of wires of various kinds are a number of very valuable electric light and motor wiring tables.

Interior conduit material receives the next attention and is properly set forth in a few very nicely arranged pages. Test instruments come next with a very large line of the celebrated Whitney instruments illustrating for the first time a number of their latest types.

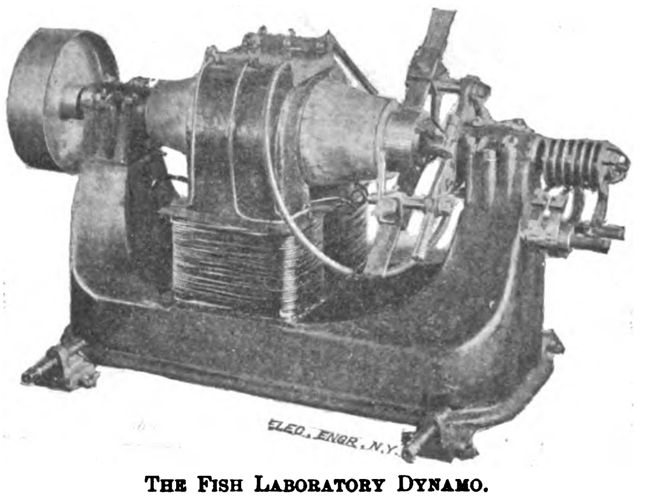
A very full line of Meston motors closes the electric light department of the catalogue, the remaining one hundred pages being devoted to an attractive arrangement of electrical house goods, telephone and telegraph supplies, and fire alarm and district telegraph material, making a catalogue of 350 6 x 9 inch pages. Every article has its own trade number and also a telegraph code word, so that the possibility of mistakes in placing orders either by mail or wire is reduced to a minimum.

The whole book is very completely indexed, there being three full indexes, the first an alphabetical index of contents, then an index to trade numbers and lastly an index to code words, so that any article in the book can be found immediately either by name, trade number or code word.

THE FISH LABORATORY DYNAMO.

The accompanying engraving illustrates one of a pair of dynamos recently built by the H. C. Fish Machine Works, of Worcester, Mass., for a New England college laboratory. The machine is of 3 K. W. output at 120 volts, direct current, with contact rings placed on the end of the shaft for two and three phase alternating current. From the two opposite bars of the 48 part commutator, two leads are taken through the hollow shaft to two collecting rings, giving a low-frequency alternating current. From the bars at 90 degs. from these, leads are taken to the next pair of rings, giving a second alternating current 90 degs. behind the first; and from three equidistant points on the commutator leads are taken to three rings, from which a three-phase current may be taken.

These machines may be used in several ways. Thus they may be run as direct current generators, for which purpose they are over compounded and provided with a series shunt for regulating the rise of pressure at the terminals; at the same time, one, two, or three phase alternating current may be taken off. Or they may be run as direct current motors and the same alternating currents taken off, thus forming a direct to alternating current transformer. Or one may be run as a generator and the other gotten up to synchronism as a direct current motor and then the alternating current switched on, when it will continue to run as a self-exciting, synchronous motor.



THE FISH LABORATORY DYNAMO.

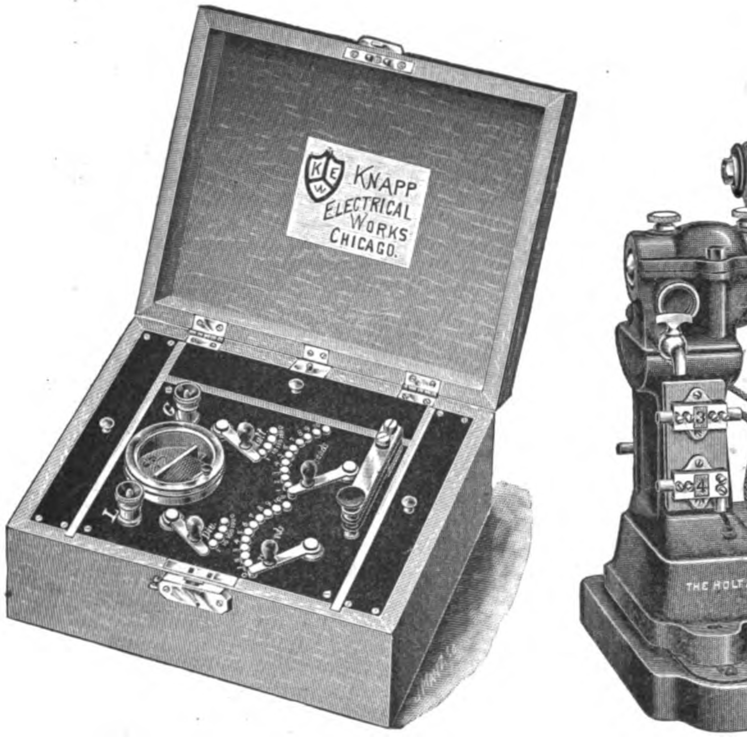
These machines are provided with self-centring bearings, and self-oiling boxes. The fields are of steel castings thoroughly annealed.

THE F. P. LITTLE ELECTRICAL CONSTRUCTION AND SUPPLY CO., of 135 Seneca street, Buffalo, N. Y., announce that their agents for New England are Messrs. G. M. Angier & Co., 116 Bedford street, Boston, Mass., and that their general western agents are Messrs. McDougall, Lucas & Co., The Rookery, Chicago, Ill.

THE "CHICAGO" INSPECTOR'S TESTING SET.

NOT many years ago the magneto testing generator was considered the *vade mecum* of the lineman, constructing engineer, inspector or general electrician. With it they tested for grounds, escapes, insulation and often guessed at the resistance. Gradually, as the demands became more exacting, more reliable apparatus for testing all forms of electrical installations was required, because the capacity and scope of the magneto were soon found to be so limited as to render its use quite unsatisfactory and unreliable. While the manufacturers were not slow to respond to the demand for something more elaborate, the apparatus supplied was generally very expensive, liable to damage in handling, often bulky, and hence inconvenient; besides, it was not always absolutely accurate.

These various objections, it is claimed, have been entirely overcome in the "Chicago" inspector's testing set, now being introduced by the Knapp Electrical Works, of Chicago. The illustration gives such a good idea of the set that an elaborate description seems superfluous. The combination includes a battery, bridge and very sensitive galvanometer, all in a neat hardwood box. The resistance and bridge coils are so arranged that a measuring capacity of from $\frac{1}{10}$ ohm to 10 megohms is obtained with the least possible number of contacts. There are several other advantages, such as the absence of loose plugs, which so often are lost; the fact that the case can be readily opened for inspection; the method of automatically opening the battery circuit by the act of closing the lid, and last, though not least, its extreme accuracy. An instrument fulfilling all these points cannot fail to meet with the approval of inspectors, superintendents, and others connected with electrical enterprises.



"CHICAGO" INSPECTOR'S TESTING SET.

THE NASH SCIENTIFIC PAINTS.

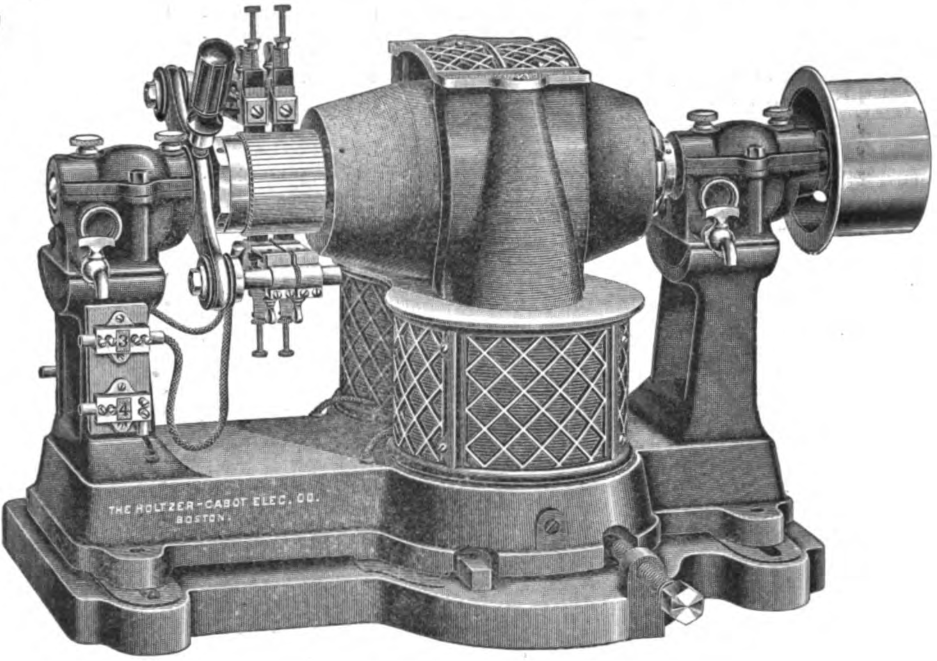
FROM our earliest recollections we have seen paint all around us, often to beautify, always to protect other materials, and we have conceived some general idea about it, but few have stopped to consider what it really is. A thin scale of pigment, held on to other materials by another thin scale, that of dried oil. How much has been demanded of this slight, weak layer of oil and color. In no other business is so much asked of so little.

The experiment has been often tried to thicken the usual coat of paint by putting on a number of coats, but when it got of any considerable thickness it frequently all peeled off. For the last fifteen years Mr. F. J. Nash, of the F. J. Nash Manufacturing Co., Nyack-on-the-Hudson, N. Y., has worked at paint on a different line. He has made it to have an affinity for, and to become part of, the surface of metals, so that it cannot be removed unless the surface of the metal is removed; this carries with it an exemption from oxidation of the surface of the metal. For wood Mr. Nash has made paints that enter and go down into the grain of the wood, and get a secure hold there. This carries with it the sealing up of the grain of the wood.

But there was another thing for paint to do, in these latter days. A new force had turned its destructive trend underground and was decomposing metals there at a rate and with a completeness that simple oxidation never equaled. Electrolysis of metals underground, Mr. Nash claims, can be thoroughly and completely prevented by first carefully painting one coat after another as they dry with his paint for metals, second, with his insulating paint, and third with his underground paint, which has incorporated with it, by his special processes, materials which have an historical record for preserving materials put underground for several thousand years. These are scientific paints of his invention which have now been in use for many years by the most competent judges. They make a more substantial thing of a coat of paint than it ever was before, and one made in accordance with the nature of the different materials it has to protect.

THE HOLTZER-CABOT "D. F." MOTOR.

THE motor here illustrated which is manufactured by The Holtzer-Cabot Electric Co. of Boston and known as type "D. F.," is a good example of the inverted pole class of machine, and every detail of design and workmanship has been carried to a high degree of perfection. The strong features about this machine are the drop forged fields of the best soft iron, the well-proportioned mica insulated toothed armature with metal ventilating heads and heavy hard drawn copper commutator which, it is claimed, for good construction and high insulation, cannot be surpassed. Ball and socket self-oiling bearings are used and a double oil gauge is provided so that oil rings and reservoir can be readily inspected in whatever position the motor may be placed.



HOLTZER-CABOT "D. F." MOTOR.

The speed of this motor is low considering the high efficiency shown, being in the 2 h. p. machine only 1,400 revolutions per minute. The brushes are of an entirely new design and have, it is said, received the unqualified approval of all who have inspected them. They are of the clamp carbon type in which the feed is in a true vertical line and the adjustment perfect. They also have the peculiar merit of having no loose nor working joints entering into their construction. This reduces the liability of imperfect contact and makes rattling or excessive vibration impossible. The field coils are wound on easily removable spools and, as shown, are surrounded by a light metal cage which adds greatly to the general appearance of the machine as well as protecting it from external injury. These motors are noiseless in operation and the regulation, owing to the careful proportioning of the field, armature and magnetic circuit, is thought to be practically perfect. They are wound to voltages of 110 to 500, and are carefully tested and fully warranted before leaving the factory.

MR. GEO. W. G. HOLMAN, formerly one of the electrical engineers of the Mather Co. has been appointed secretary, treasurer and manager of the Cheltenham Electric Light, Heat & Power Co. of Philadelphia, and has entered upon his new duties.

WESTERN NOTES.

The L. K. Comstock Co., Chicago, have recently secured the contract for the construction work of the incandescent plant for the Leland Hotel.

Mr. Chas. D. Jenney, of the Jenney Electric Motor Co. was in Chicago last week looking after the details of some large contracts recently closed through their Chicago office.

The Knapp Electrical Works, Chicago, are meeting with good success in the sale of their toothed type transformers, orders coming in daily in sizes of from 50 light capacity up.

Mr. W. R. Pinkard, for a long time in charge of the house goods department of the Ansonia Electric Co., has accepted a similar position with the Central Electric Co., Chicago.

The Metropolitan Electric Co., Chicago, have just made arrangements for the western agency of the Dayton Fan and Motor Company's ceiling and desk fans. They are also handling the Gibbs trolley and trolley parts.

The Vilter Mfg. Co., Milwaukee, report that the 1,200 h. p. tandem compound engine, placed in the Minneapolis General Electric Co.'s power house some months ago, is giving excellent results in steam economy, regulation, etc.

Mr. M. B. Austin, of the Knapp Electrical Works, Chicago, has just returned from a five weeks business trip among the principal supply houses of the country. Mr. Austin reports having secured some very good orders for "everything electrical."

Ansonia Electric Co., Chicago.—Mr. J. B. Waller, assignee, is making active preparations to close out the entire stock of electrical supplies by the first of May, or as soon as possible thereafter. It will pay all interested, to write to him for quotations on anything in the way of electrical appliances or supplies.

Mr. Emil Grah, Toledo, Ohio, one of the pioneers in the electrical construction business, was in Chicago last week, arranging for the shipment of the necessary construction material to be used in the wiring of the National Union Building at Toledo. Mr. Grah will use Okonite wire, and Interior conduit exclusively.

The Xentric switch, handled by the Metropolitan Electric Company, is not as generally known as some other switches on the market, but where it has been introduced, it is found by practical men to be very satisfactory. It is the latest improved device in switches, and is made by the well known switch manufacturer, Mr. H. T. Paiste, the Metropolitan Electric Company handling his specialties.

Mr. Arthur Singer will hereafter have charge of the City department of the Metropolitan Electric Co., Chicago. While this is Mr. Singer's first experience in the electrical field, he is by no means a novice in business matters, having been associated with one of the largest mercantile houses in the West, and will therefore prove a valuable acquisition to the staff of this progressive concern.

The Bryant Electric Co., Monadnock Building, Chicago, are meeting with much success in the introduction and sale of their new 500 volt special cut-outs, made according to the rules, and meeting the approval of the underwriters. The Messrs. Grier also announce that they have a quantity of new No. 4 and 5 weatherproof wire, on which they will make a special price as the handling of wire is not at all in their line.

The increase in the demand for electrical porcelain goods has been very marked of late, particularly since the underwriters and electrical inspection departments in nearly all of the large cities are demanding the use of porcelain cleats, insulators and tubes in place of wood or rubber. Anticipating somewhat the increased demand for these goods, the Electric Appliance Company have largely increased their porcelain line and are prepared to furnish from stock porcelain insulators, cleats and window tubes in almost any quantity.

The Racine Hardware Co., Racine, Wis., are getting out a new catalogue covering the products of their engine department. This company is the successor of the Racine Hardware Mfg. Co. and although their works resumed operations only about a month ago, many orders are already coming in for their well known high speed electric light engines. These engines, as now made, contain several changes and improvements making them practically perfect.

The Central Electric Company have placed their house goods and retail departments in charge of Mr. W. R. Pinckard, who has had several years experience in those lines, and is personally well-known to the electrical fraternity. This company report that their business in these two departments is increasing so rapidly that they find it necessary to increase their facilities. One of the most important specialties in the house goods department is the assortment of Edison Lalande batteries, physicians' supplies, battery fan motor outfits, etc., manufactured by the Edison Manufacturing Co. and for which the Central Electric Co. have special selling arrangements.

Mr. John L. Martin, the electrical engineer, slipped on the platform of the Illinois Central at Sixtieth street last week, as a train passed, and only saved his life at the expense of an arm. It is hoped that this accident may not terminate fatally.

St. Louis, Mo.—Shortly before midnight March 22, lightning struck the wires leading into the car sheds of the Missouri Street Railway Company, in Cardinal avenue. In an instant the place was in flames. There were eleven motor cars and forty-eight trailers in the building, and all were burned. The sheds were destroyed by fire two years ago in the same manner. The loss will reach $80,000; fully insured.

Cleveland.—The repair shops of the Cleveland Electrical Company in Pearl street, caught fire soon after 3:30 o'clock a. m. on March 21. The flames gained considerable headway before an alarm was sounded and spread with great rapidity. The repair shop, a one-story building 100 feet long and nearly 100 feet wide, was burned to the ground. All the valuable machinery which it contained, including several motors, was completely destroyed. The loss will aggregate about $50,000, covered by insurance. The car barns were saved.

The Wallace Electric Co., Chicago, are busy mailing their Catalogue A, containing a complete list of electric railway and other electrical supplies, handled by this house. The book is of the usual catalogue size, gotten up in a neat and systematic manner, and reflecting much credit upon the compiler. Unlike many publications of the kind, it is not encumbered with a number of cuts of insulators, pins, brackets, tools, etc., and the list of goods described and illustrated is confined to standard goods which the company are prepared to ship promptly.

Mr. Wells Goodhue will hereafter conduct under his own name the business formerly carried on under the firm name of Goodhue & Lincoln. Mr. Goodhue is well known in the electrical trade and feels confident that he can offer many advantages to intending purchasers. He will continue to handle the same specialties that he has so long been identified with. The Wagner direct and alternating current power motors, Wagner fan motors and Sunbeam lamps will receive the large part of his attention. He also has a large assortment of second hand Westinghouse and Slattery transformers.

The Electric Appliance Company report that their fixture business has increased to a point where they find it necessary to carry a large line of fixture accessories in stock in Chicago. They are prepared to furnish from that point a full line of electric glassware insulating joints, electrolier wire, fixture cut-outs, etc. The electric light equipment of the large addition to the Chicago post office has been made very complete in every respect, every cabinet and desk being equipped with the most effective kind of electric and combination fixtures. The contract for furnishing these fixtures has just been completed by the Electric Appliance Company. The contract was secured only after considerable competition and the Electric Appliance Company feel considerably elated at having been able to secure it.

NEW YORK NOTES.

The Manhattan General Construction Co., 50 Broadway, and also of the Equitable Building, Baltimore, Md., have been appointed by the Buckeye Electric Co. their sole agents for New York and vicinity and Baltimore and vicinity. F. H. Prentiss is president; S. Marsh Young, vice-president and general manager; H. M. Steele, treasurer, and R. W. Hildreth, secretary.

Sheaff & Jarstad have established themselves lately as engineers at 85 Water street, Boston, and are quite busy. Mr. W. N. Sheaff, E. E., while in this city last week, reported some large and important contracts in the hands of his firm. One of these is the work for the Fairhaven & Westville Ry. Co. of New Haven, whose work is very extensive, the power house being about 1,000 h. p.

H. B. Coho & Company, of the Mail and Express Building, 203 Broadway, New York City, are now contractors for the apparatus manufactured by the Mather Electric Company, of Manchester, Conn., for New York City, Brooklyn and vicinity, and eastern New Jersey. Mr. Coho is well known through his connection with the Waddell-Entz Company, as their general sales agent, and proposes to make a strong fight for Mather business in his territory. Mr. Thomas C. Perkins, vice-president of the Mather Electric Company, who is in New York City much of the time, will also make his headquarters at 203 Broadway.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

BRA

THE
Electrical Engineer.

Vol. XVII. APRIL 4, 1894. No. 309.

TUDOR STORAGE BATTERIES IN THE CENTRAL STATION OF THE EDISON ELECTRIC ILLUMINATING CO., OF BOSTON.

BY

A. C. Shaw.

INTRODUCTORY.

THE practice of using the storage battery as auxiliary to the steam engine and dynamo in central stations, is at last beginning to receive the attention which it deserves in this country, though it has become quite general in Europe during the past few years. Several stations in this country have within the last year been equipped with batteries, and in this article we describe the plant which has just been installed in the new central station of the Edison Electric Illuminating Co., of Boston, on Atlantic avenue, the largest storage battery plant in this country.

The adoption of this system of storage batteries is the outcome of careful investigations by Mr. C. L. Edgar, general manager of the company, during recent visits to Europe, where he inspected all of the more important central lighting stations of European cities and became much impressed with the excellent results obtained from storage batteries as auxiliaries to large lighting plants. The installation of the batteries has been in progress for some months and at the present writing the work is completed and the batteries will be put in service within the next few days.

The installation of such a plant is a work of greater magnitude than might be supposed on first thought, the switchboard with its automatic regulating devices being an elaborate piece of engineering, extremely interesting in its details. When using the batteries exclusively for the supply of current it becomes necessary, as the batteries become more and more exhausted and the voltage falls, to cut into circuit more cells, and, as this is all done automatically, the method of its accomplishment involves much ingenuity of design, and will be found extremely interesting.

THE BATTERY ROOM.

The cells, 140 in number, are situated in a room outside the present station, and immediately behind the present switchboard. This room, shown in Fig. 1, measures about 60 feet long by 37 feet wide, and is about 13 feet high. It contains five rows of cells, divided into two sections, so that there are 70 cells on each side of the system. The cell itself is a box of hard pine wood 1 inch thick, with 1½ inch frames, and measures 41 inches wide, 17 inches long (in the length of the row of cells) and 35 inches deep, and is lined inside with lead 1/16th inch thick. In each cell are 18 positive plates and 19 negative plates, there being a negative plate at each end, whose inside face only contains active material.

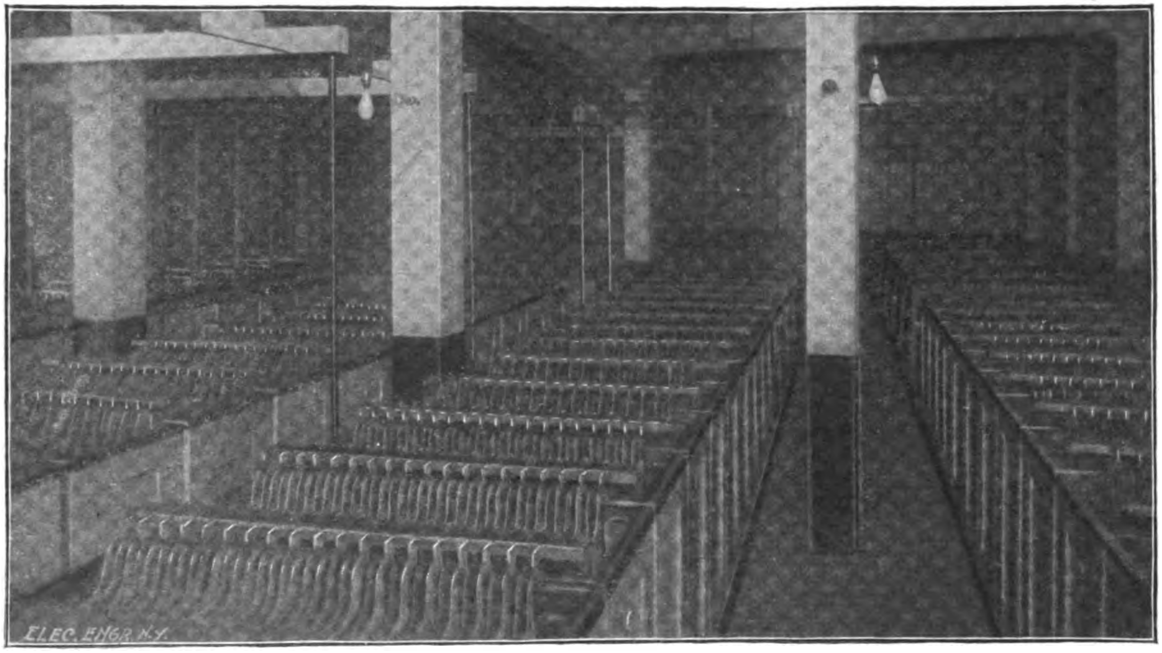


FIG. 1.—STORAGE BATTERY ROOM OF THE EDISON ELECTRIC ILLUMINATING CO., OF BOSTON.

The lead plates are 28 inches deep by 15 inches wide, the negative being ⅜ inch and the positive ⅝ inch thick. In construction the positive and negative plates are somewhat different, the positive plate being a grid of hard bismuth lead, upon which are hung by soldered connections, eight plates, 7 inches square, containing the active material, which plates can be readily removed at any time, and fresh ones substituted. The negative plate, on the contrary, is simply composed of two 14 inch square plates containing the active material, soldered one on top of the other, so as to make one large plate. These plates are suspended by lead lugs on either end, on two ⅜ inch glass plates, which rest on the bottom of the cell, the bottom of the lead plates being 5 inches from the bottom of the cell, and the top 2 inches from the top of the cell.

The plates are separated from each other by two rows of ⅜ inch glass tubes, long enough to reach the bottom of the cell, and at one side of the plates, when set up, there is placed a leaden spring, to keep the plates steady in position. The lugs of the plates are soldered to a heavy lead bar, 3½ inches wide by ⅜ inch thick, between each cell, and on a few of the end cells this bar is ¾ inch thick. These bars are also in certain cases, where the current is heaviest, reinforced by copper rods, soldered to the bars to aid the conductivity. Dilute sulphuric acid is used, and about 320 litres are required for each cell. The connections between the cells and the switchboard, are soft copper bars, bolted together, 2 inches wide and varying in thickness from ⅜ inch to ¾ inch as may be required. Considering one side of the system, all 70 of the cells can be joined in series, but in addition, 30 of these have direct connection with the switchboard, so that by the automatic regulation, any number of cells, from 40 to 70, can be used in series for discharging. There are thus 31 copper bars in each side of the system, 62 in all, and two neutral bars, which lead from the battery room to the switchboard. These bars are all supported overhead on wooden frames, provided with porcelain insulating blocks.

Great attention has been given to the matter of proper insulation, and a brief description of the foundation on which the cells rest will be found interesting. The floor of the room is of cement, in which is set a frame work of wood, upon which rests a substantial insulation composed of alternate layers of glass and wood. On top of these insulating blocks is placed a framework of iron I beams, which supports the weight of the cells, but which is insulated from them by porcelain blocks.

The voltage of each cell is 1.83 while discharging, and 2.6 volts are used when charging with about 664 amperes. In discharging, the following figures have been deduced ; it being remembered that the output represents the result from only one side of the system.

At the rate of	1,650	amperes,	1,900	amp.	hours	were	given out.
"	850	"	2,875		"	"	"
"	580	"	2,902		"	"	"
"	453	"	3,175		"	"	"
"	347	"	3,470		"	"	"

THE SWITCHBOARD AND AUTOMATIC REGULATION.

Directly underneath the special switchboard which has been installed for this work, and for the purpose of operating the mechanical part of the automatic regulation, are situated two 4 horse power 30 volt electric motors taking current from the batteries, and belted to the mechanical device above. The switchboard, which is shown in Fig. 2, is 39 feet long by 7 feet high and is divided into two halves, one for either side of the system, and both precisely alike, so that a description of one-half will suffice for both.

It is chiefly composed of six horizontal brass slides, connected with the regular Edison bus wires on the main switchboard of the station. Directly opposite these brass slides are six other slides, composed of insulating material, but in which are 31 brass strips, which form the terminals of the 31 copper bars connected to the 30 cells in the battery room previously referred to, which it is desired to cut in and out of circuit at will. Between each pair of brass slides and battery slides, and running parallel with them, is a screw shaft on which travels a substantial metallic brush, making connection with the bus on one side and the battery on the other. By moving this brush, it will at once be seen that any number of cells from 40 to 70 can be

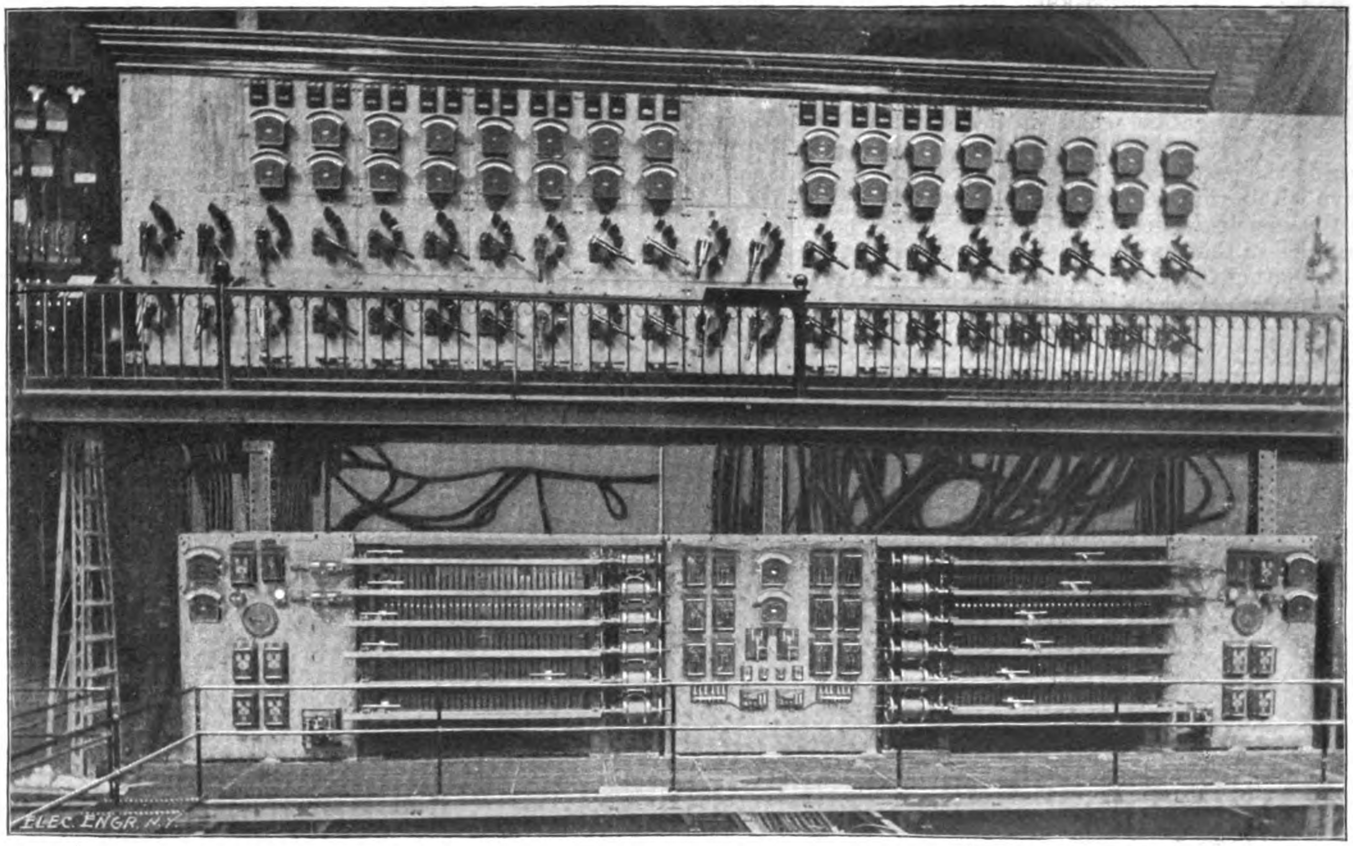


FIG. 2.—STORAGE BATTERY SWITCH BOARD OF THE EDISON ELECTRIC ILLUMINATING CO. OF BOSTON.

thrown in or out of circuit as desired. As this station is provided with five separate busses, five sets of slides are necessary, the sixth and bottom slide being used for charging the cells, and being provided with an automatic cut out. Adequate switches are provided between the slides and the busses, so that the entire battery switchboard can be cut out of the main circuits when it is not required to operate the cells.

At each end of the board are situated five relays, one for each set of slides, and also a reserve one in case the bottom slide should ever be used for discharging purposes. Each relay is set to the standard voltage (say 110 volts) and controls the voltage of the others, which in turn control the automatic switches in the centre of the board, between the two halves just described. These automatic switches have mercury contacts and are delicately balanced, and operate the motors below which furnish the power to turn the screw shafts. These motors run only in one direction, but, by a system of bevel gears containing magnetic clutches on the end of the screw shaft, the latter is turned in either direction, as dictated by the automatic switch. Brakes are also provided to overcome the inertia of the machinery and to bring the brush to a stop quickly.

The whole device is extremely ingenious, somewhat complicated at first sight, but, when explained, becomes very simple and easy of operation. It is simply a device, automatic in its action, and controlled by electric relays, which cuts in or out any number of cells, so as to maintain the voltage on the bus bars at the standard voltage required, and is somewhat complicated from the fact that in this particular station five different busses are used on either side of the system, requiring different voltages in each.

Though the Edison Company are using their regular generators for charging at present, a special engine and generator will be installed in the future, of special voltage, so as to easily charge all the cells in series.

The cells were furnished and the plant installed by the Accumulatoren Actien-Gesellschaft Hagen i. W. Germany. It was put in operation for the first time about ten days ago and the final capacity tests were made last week in the presence of Mr. C. L. Edgar and Mr. A. Müller, the representative of the Hagen Company. The tests proved eminently satisfactory, the capacity at the highest rate of discharge exceeding by about 15 per cent., the guaranteed capacity.

This is the first plant installed by the Hagen Co. in this country, but its work in Europe covers one hundred central stations and three thousand isolated storage battery plants.

PROGRESS OF EXHAUST STEAM HEATING.

BY

D. H. Babcock

In The Electrical Engineer of April 5th, 1893, Mr. Leslie W. Collins had quite an exhaustive article on the Springfield, Ill., electric light and steam distribution plant, showing a diagram of their steam heating mains, and detailing somewhat the progress made during the previous year. Since that time the Springfield Electric Light and Power Co. has made quite a large extension of its heating mains, and also contracted for the exhaust steam from the electric railway company; having laid a ten inch main to connect with the exhaust pipe at the railway power station. This gives a continuous supply of exhaust steam day and night in the territory occupied. The income from heating, has increased more than 50 per cent. over the previous year, and will amount to $12,000, this present season. We have the statement of their manager that the total expense, chargeable to the exhaust steam account, will not exceed $2,000, leaving a net income, due to the exhaust steam addition to the electric plant of $10,000. The total investment on this account, has not been more than $25,000; the annual cost for repairs up to the present time has been practically nothing; it is not, therefore, surprising that the electric light company is more than ever enthusiastic over the success achieved in this added branch of its original enterprise. At the present rate of growth of its steam heating business, it is not too much to expect that within two years its net income from the sale of exhaust steam, will pay a very handsome dividend upon the total investments for both steam and electricity.

This condition does not call for any special comment, as the facts speak for themselves. A good many other electrical companies have been watching what they regard as the experiment of the Springfield Electric Light Company in its use of exhaust steam; and it is a matter of no small moment to all of them. It is the current belief that electric light companies are not working on a very liberal margin of profit. They have to compete with the gas companies, who have been able to reduce the cost of gas making materially, and although electric lighting is a great step in advance, yet it is a fact that the *price* still controls to a great extent, and not the quality. The gas companies will not be driven from the field, and will be found doing business at the old stand for many years to come.

The electrical field has been a favorite one for investors, for the last few years, and an immense amount of money has been placed in these enterprises. How to make the business profitable is now a matter of the first importance with these corporations. The laws of competition and traffic cannot be evaded, and are as binding as any other laws regulating human affairs. The stern reality of these laws enforces still more the necessity for economy in conducting the business affairs of companies. If the company can coin $10,000, or any other amount of money out of what it now allows to go to waste, it is by such an act looking after the interests of its stockholders in a practical way. On the other hand, if it allows the value of $10,000, more or less, to go to waste, which it might coin into so many dollars, it must stand convicted of neglect and of a failure to conduct its affairs with common business prudence.

The gas companies are doing, in this respect, what the electric companies are not. I have it from the reliable manager of a gas company in an Eastern city, that its residuums, or by-products, sell for more than the cost of making its gas. The coke, ammonia, and other products resulting from the process of gas manufacture, are all carefully husbanded and sold; which helps to maintain the competition with the more popular, but more costly, electric lighting. The electric light company has no more warrant for allowing its exhaust steam to be dissipated into the air, than the gas company would have, to dump its coke and other by-products into the river that flows past its works. There are many manufacturing enterprises, which live and flourish by the sale of their by-products. If these were allowed to go to waste, the company or concern so doing would soon go into bankruptcy. This is precisely the case with the electric light companies, and the sooner they come to a realizing sense of their situation, the better it will be.

The Springfield Electric Light Company has been mentioned as a conspicuous example of true economy in its business, there are several others which have entered the same field, and which are succeeding to a similar extent. The manager of the Cedar Rapids Electric Light and Power Co. says he would not run an electric light plant without an exhaust steam system of distribution, for the reason that it could not be made to pay, and similar statements are made by managers of other companies, who are thus disposing of their exhaust steam.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—VIII.

BY

Mary A. Henry

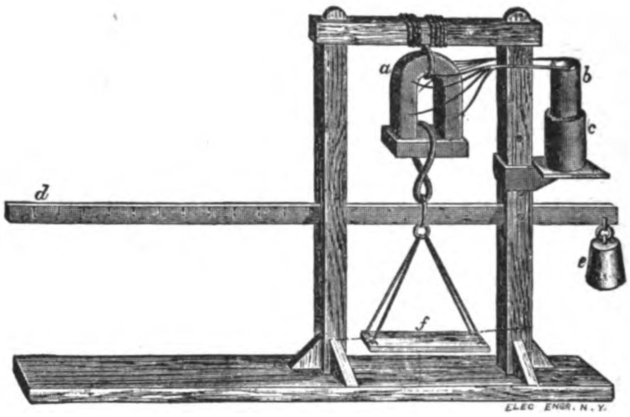
THE telegraph in Henry's room was sufficiently complete in all essential particulars to be prepared for public use; but Henry says, of the arrangement we have described, "it was merely a temporary one, I had no idea of abandoning my researches for the practical application of the telegraph." The bell rung by electricity attracted great attention; Henry's friends urged him to take out a patent for his apparatus, but he refused. On a paper lying on my desk are these words in his handwriting:—"Why did not I take out a patent for my application of the electro-magnet to the telegraph? * * * * *I thought it unbecoming the dignity of true science to curtail the use of a discovery to personal and selfish ends; on the contrary I thought it right to give it to the world, as a means of advancing humanity.*" When Henry had proved that his experiments had solved the problem of distant communication, he left the telegraph, for a time, to investigate the curious phenomenon of the induction of an electrical current in a long wire, which he had observed in the experiments in the long room.

It was a brilliant spark, it may be remembered, which, as Henry was disconnecting one end of a long wire uniting the poles of a battery, drew his attention to this phenomenon. The discovery to which it led him, of self-induction, or the "extra current," as it has been called, opened a new field of science; that of the induction of currents. In this field Henry's name and that of Faraday must be always associated; for these two men were the first to enter it; but it should be noticed that it was Henry who opened the field and that in this year 1830 he was alone in it. Faraday entered with the discovery of magneto-electricity but not until August 1831. And it was not until the summer of 1834, four years after Henry, that he made the same discovery of the extra current, to investigate which Henry now leaves the telegraph.

It is November 1830 before we find Henry at work again on his magnets. He is in a new room in the basement of the Academy; it is more comfortable in many ways than the upper room, since it is provided with a furnace and other conveniences for research, while a room in the rear is useful for many laboratory purposes. The intensity magnet of a long single wire has proved its value, in its power to act at a distance, and Henry has now turned his attention to the quantity magnet with its many coils. When we left it, the reader will remember, it was lifting fifty times its own weight with only two very small galvanic plates, leaving far behind the feeble Sturgeon magnet with its large battery. Henry is now making, on the same plan, a larger magnet, winding as before on an iron bar a number of separate coils which could all be united so as to form one single coil while each could be used separately or in combination.

The bar of soft iron was two inches square and twenty inches long; it weighed twenty-one pounds; it was wound with copper bell wire in nine coils of sixty feet each. It was in the form of a horse shoe and was suspended in a rectangular wooden frame three feet nine inches high. An iron bar was suspended below the magnet so as to act as a lever and the different weights supported were estimated by a sliding weight in the same manner as with a steel-yard. The picture of the magnet given is from Henry's paper.

Henry experimented in various ways, attaching the wires, now in one combination now in another, to the battery until, when "all the wires (nine in number) were attached, the maximum weight lifted was 650 lbs." and this result "was produced by a battery containing only two-fifths of a square foot of zinc surface and requiring only half a pint of diluted acid for its submersion." Not content with this result Henry forced the magnet at last to sustain "750 lbs." "In this case a plate of zinc, 12 inches long and 6 inches wide and surrounded with copper, was substituted for the galvanic elements before used." There stood then in Henry's room the most powerful magnet in the world, we quote again from his paper. "The strongest magnet of which we have any account is that in the possession of Mr. Peale of Philadelphia; this weighs 53 lbs. and lifted 310 lbs., or about six times its own weight. Our magnet weighs 21 lbs. and consequently lifts more than thirty-five times its own weight; it is probably then the most powerful magnet ever constructed." In speaking thus of his magnet Henry was comparing it with the permanent steel magnets which had been so long in existence, in which magnetism had been produced by rubbing or by contact with another magnet; the only electro magnet with which Henry at that time could compare it was the feeble instrument of Sturgeon.



HENRY'S MAGNET OF 1830.

This is Henry's first quantity magnet of any considerable size, but it has a much deeper interest, for it is the one with which we first see Henry producing the phenomenon of magneto-electricity. He carried it one day to that long exhibition room, where we have before seen him at work. "A piece of copper wire about thirty feet long and covered with elastic varnish was closely coiled around the soft iron armature" the ends of which were connected with a galvanometer forty feet away. The question to be asked—an experiment is always a question—was:—can magnetism produce electricity? This was an old question, asked first a decade before, when Oersted found out the opposite;—that electricity could produce magnetism. Henry's magnet answered *yes* to the question; for when it was excited a current of electricity was produced in the wire around the armature, as the moving of the needle of the galvanometer indicated. Faraday later obtained the phenomenon much in the same way, but he published first, and so Henry in accordance with scientific codes laid down all claim to the discovery. Henry had at that time, beside Dr. TenEyck, another assistant, Mr. George W. Carpenter. The following extract from a letter written by him last Fall are interesting, in connection with this matter.

> "I was a pupil of Professor Joseph Henry, in the year 1826, when he was appointed to take charge of the mathematical department in the Albany Academy. Subsequently I was an associate teacher with him in the same institution. * * * * It was my pleasure to aid him in his new and wonderful experiments in magnetism and electricity. * * * * In a well remembered

> conversation with me * * * * he alluded to an incident in his own experience. After retiring one night he worked out mentally how he could probably draw a spark from the magnet. Upon rising in the morning he hurried to his working room, arranged the apparatus, tried the experiment, when success crowned his labor. He had accomplished what had never been done before. Unfortunately he failed to publish his discovery. In continuing his remarks he added that Faraday, the great European philosopher, some time after, successfully tried the same experiment, and at once announced it, unfortunately before Professor Henry's success was publicly known. Mr. Henry regretted, that through his own negligence, he had been deprived of the honor awarded to Faraday."
>
> GEORGE W. CARPENTER.
>
> ALBANY, N. Y., Nov. 15, 1893.

Let us now look again at the picture of the magnet. There is only one battery. In the picture this rests on a bracket on one side of the frame. Sometimes Henry attached another exactly similar to the other side of the frame, and we ask our reader's especial attention to this, for here is the beginning of pole-changers, duplex telegraphs and all the electric motors which now so excite public attention. Henry attached the wires of his magnet to these two batteries in such a way that he could use either battery and so send the electric current in one direction or the other according to his pleasure. Did it make any difference to the magnet if the direction in which the electricity came to it was changed? Yes, for it changed the poles.

Let us look at Henry as he lifts the galvanic element b from the cup c, the current is broken, the magnet is dead, the weights ought to drop, but so quickly does Henry put the opposite battery into its cup, that the weights have not time to fall before the magnet is a magnet again. The magnet has been unmade and remade in an instant; but it has undergone a change, its + pole has become a — pole; its — pole a + pole. This pleased Henry; sometimes before his classes he performed the operation slowly, so that the weights would drop a little from the magnet to be caught back by it before the limits of the attractive power were passed. It really seemed as if an invisible supernatural power were at work, dropping and lifting the weights and the experiment never failed to excite the enthusiam of the class. How Henry used this pole-changing to make really the first electric motor we will see a little further on.

Want of space forbids the notice of many other interesting experiments Henry made with his new strong magnet. He named his magnet of a single coil, an *intensity* magnet, because it must be used with a battery of many plates, called an intensity battery. His magnet of many coils he called a *quantity* magnet, because it must be used with a battery of a single pair of plates known as a quantity battery.

It should always be remembered that he not only made these two magnets, he discovered the law which controlled their indispensible connection with their respective batteries. Prof. Lovering says, "The fertile principle he deduced from his experiments, his distinction between quantity and intensity magnets, and between quantity and intensity batteries, although now differently expressed, is all important and of manifold application. Every experiment with electro-magnetism in the laboratory, in the lecture-room and in the arts, is a success or a failure in proportion as this law is obeyed or ignored."

This law of electric flow and electric resistance is now expressed in units by ohms, this brings us to the position in which Henry and Ohm stand to this law. In far distant Nuremburg, Ohm devised a theory of such a law, in other words suggested that such a law might exist and expressed this idea in a mathematical formula. Henry discovered the law. We would here as in our former articles ask our readers to consider the difference between a theory and a discovery. A theory suggests *what may be; it may or may not be true;* however ingenious, it affords at best only an intelligent mode of asking Nature a question. *A discovery finds out what actually exists.* Ohm's mathematical formula cannot be too highly prized; but it should not outrank the discovery. It was not until 1836 that it came into notice; at that time the practical results of the discovery, Henry's means of magnetization, introduced through the medium of Silliman's journal in 1831 had been five years in use. They had been so quickly and widely disseminated that the world had already accepted them as a matter of course, as the sunshine and the rain, unmindful almost, as of these blessing, that they must have had a giver. In 1834 we find Henry in a letter to Dr. Bache asking "Who is Ohm? What is his theory?" but it was not until 1837, when he was in London, that he obtained a sight of it, only to find that it was his own discovery mathematically expressed. The two men should always be associated, Henry the discoverer wresting from Nature the law, by patient labor and entelligent experiment; Ohm giving the mathematical formula which facilitates its use.

Absorbed in the interest of his experiments and in the various duties of the Academy, Henry had not considered the importance of publishing the results of his researches. While engaged in these last investigations, the last number of the Edinburg Journal arrived. Opening this Henry found in it a paper from Prof. Moll of Utrecht, describing some experiments made with magnets, similar to those he had made two years before. To be thus superseded, although only in part, in publication, if not in experiment, was a trial; but the researches made by the two men were very different and in no way comparable. Henry says of Prof. Moll, "he succeeded in making powerful magnets, but made no discovery as to the distinction between the two kinds of magnets or the transmission of the galvanic current to a great distance with power to produce mechanical effects. In fact his experiments were but a repetition on a larger scale of those of Mr. Sturgeon. He endeavored to produce greater power in the magnet simply by using a larger quantity battery." Then compare the magnets;—"Henry's of Nov. 1829, lifted *fifty times* its own weight; Moll's, twice the size, lifted only *fifteen times* its own weight. Moll's greatest success was in lifting one hundred and fifty-four pounds with a twelve and one-half inch magnet: he was justly proud of it. Henry's magnet, nine and one-half inches high, lifting now seven hundred and fifty pounds, subsequently was made to lift *three thousand and fifty*. Surely it had nothing to fear in competition with those Utrich magnets. Then there was enormous difference in battery power. Moll pushed his up to seventeen square feet. Henry reduced his to a square inch."[1]

Seeing the necessity for publication Henry immediately prepared a paper for Silliman's *Journal*—which was only just in time to be published in the following number for January. (This is the paper from which we have so frequently quoted.) The *Journal* was then published quarterly. He sent with his paper a copy of Prof. Moll's, and he closes his paper with these words. "The only effect Prof. Moll's paper has had on these investigations is to hasten their publication. The principle upon which they were instituted was known to us nearly two years since, and at that time exhibited to the Albany Institute."

ELECTRIC BUOYS FOR MOBILE BAY.

Capt. W. S. Schley, and Lt.-Com. C. H. West., U. S. Navy, accompanied by Mr. Ira W. Henry, Elec. Eng. of the Bishop G. P. Co. have started for Mobile, Ala., to make a topographical survey of Mobile Bay and the adjacent shores to ascertain the practicability of lighting the thirty mile channel with electric buoys and the erection of the necessary generating plant.

The successful operation of electric buoys for the last six years in New York Bay and the fine showing in Lake Michigan during the Fair has proved the adaptability of this work to harbor lighting, and opens a new branch of Lighthouse engineering. All interested in electric work look forward to a favorable report from the party and wish them success.

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[1] W. B. Taylor, Scientific Writings of Joseph Henry.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE SILVEY STORAGE CAR SYSTEM.

In the year 1890 W. L. Silvey of Dayton, Ohio, began to make storage batteries after a long series of experiments, in which the merits and defects of almost every known cell had been thoroughly reviewed. In the summer of 1890 a train of cars on the Big Four Railway was equipped with the Silvey batteries, using 12 cells to each car and ten 16 c. p. 25 volt lamps. The light was first operated as an experiment during a run of 90,000 miles between Cincinnati and Dayton, Ohio. As a result fifty-five cars were similarly equipped on the C. & O. R. R. running between Cincinnati and New York, and during three years no such thing as a short-circuited cell or buckled plate has ever occurred. The relative cost of the coal oil, Pintsch gas and Silvey storage battery incandescent light for the year 1893, after three years of constant use, is shown by the report of chief electrician W. S. Greene, of the C. & O. R. R. just published, to be as follows: Electric light costs $17.73 per year per lamp; oil lights cost $24.12 per year per lamp; and Pintsch gas light costs $29.42 per year per gas burner or tip. The relative candle power of each light is as follows: Oil 10 candle power, gas 8 candle power and electric light 16 candle power, showing that electric light by storage batteries costs 52 per cent. less than oil and 69 per cent. less than gas light of the same candle power.

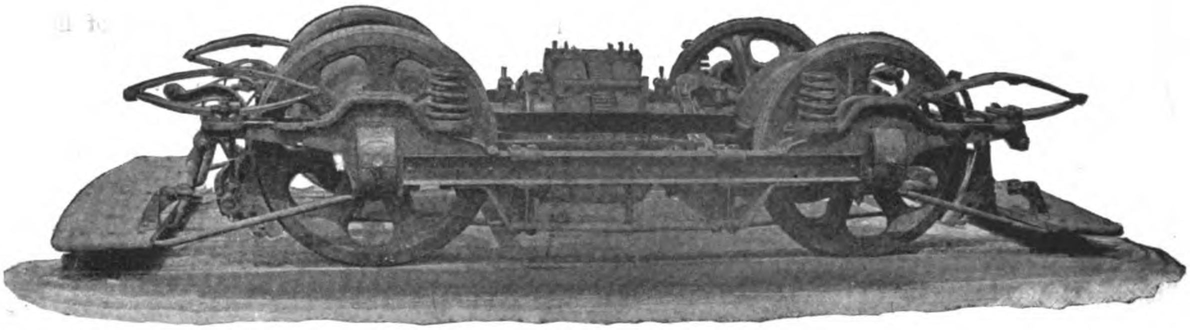


Fig. 1—Modified McGuire Truck with Silvey Motor.

The battery, after having been in daily use for more than three years proving itself eminently successful under the ill treatment and hard usage to which all railway apparatus is necessarily subjected, Mr. Silvey turned his attention to the storage battery as applied to street car traction. However, before engaging in this difficult task, he made an inspection tour throughout the country in order to become thoroughly acquainted with the causes which had led to so many failures. The result of his investigations was that he found that the batteries which had been used would in most cases give fairly good results when used for stationary work, but they were so constructed that they would be speedily destroyed by the constant jar and irregular and excessive overdischarging and overcharging to which they would be subjected on a moving street car; at one moment giving no current and at the next moment giving more than 100 amperes, and thus straining them to the utmost. Another trouble Mr. Silvey found was, that the motors had invariably been modified high potential or trolley motors excessively heavy and unsuitable for the work; the motor not being properly arranged for utilizing the current, the battery inadequate to stand the strain, and the controlling device on the platform so arranged that the current was not under proper control, only aggravated the other difficulties.

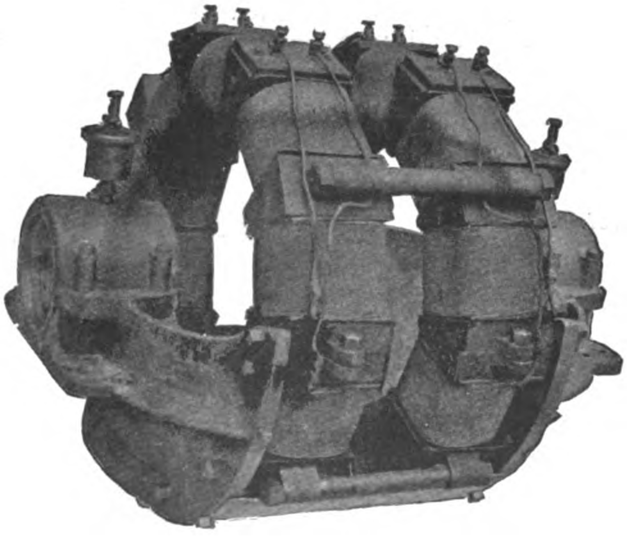


Fig. 2.—The Silvey Storage Car Motor Frame.

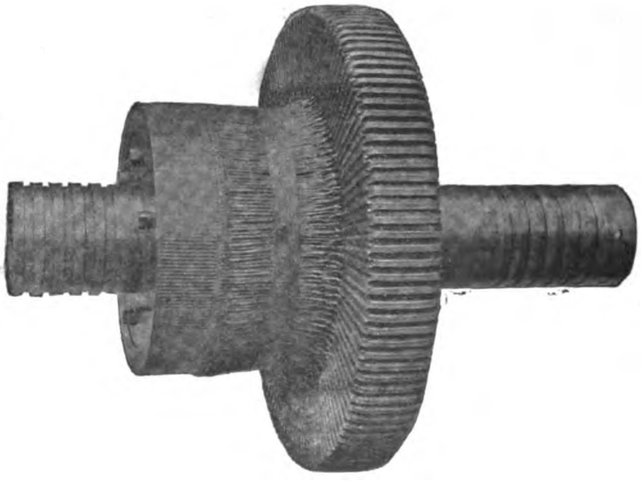


Fig. 3.—The Silvey Armature.

With the fact staring him in the face that every attempt in the United States to operate a storage car commercially had been a failure, Mr. Silvey in the spring of 1893 began the task of making a practically commercial storage battery car. The American Car Company of St. Louis was visited and one of its finest sixteen-foot car bodies ordered built specially for the work, provision being made for placing batteries in iron trays and sliding them under the seats through openings at the end of the car. A McGuire truck was ordered with specially heavy axles, the truck being modified by Mr. Silvey as shown in the engraving, Fig. 1, in order to allow a proper attachment of the motor.

The truck frame consists of two parallel frames tied together at each end and having jaws in which the journal boxes are fastened. Crosswise of this frame are two ten pound Carnegie I beams, the top parts of which are placed horizontally and on which the motor rests. As a precaution the I beams are tied together at the ends by truss shaped braces.

The motor proper is constructed as follows: Two rings of steel having numerous wedge shaped pole pieces, Fig. 2, are wound with coils of wire, the winding being such as to make a consequent pole out of each projection. These two rings are tied together by rods extending from one to the other constituting the field magnets, and between them revolves a ring armature of very large diameter. This armature, Fig. 3, is composed of a central non-magnetic spider and rim around which is wound and securely fastened a ribbon of the best quality of soft iron, until a diameter is produced as large as the field magnet rings. The armature is now taken and turned true on each face and provided with notches, and into these notches coils of wire are wound. Each slot is thoroughly insulated by mica troughs and, the armature being very narrow, the coils are completely insulated from each other, rendering a burned out coil almost impossible; besides, no bands are required. The armature coils are connected to a multiple bar commutator, and revolve between the two field magnet rings, the armature coils being at all times exposed to the full influence of the field magnets. By this arrangement a very light machine has been produced. The machine with which this car is operated has an armature ring 3¾ inches wide by 24 inches diameter, wound with 2,000 turns of No. 14 B. & S. double insulated wire weighing about forty pounds; the entire machine complete weighs 1,350 pounds and develops forty horse power. The entire equipment of motor, together with all gears, gear cases, etc., weighed less than 2,000 pounds.

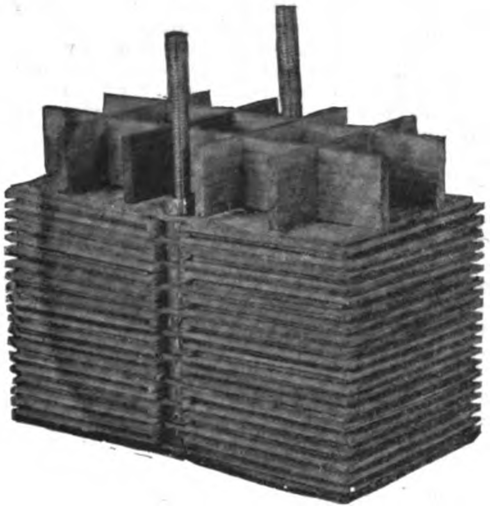


FIG. 4.—THE SILVEY TRACTION STORAGE CELL.

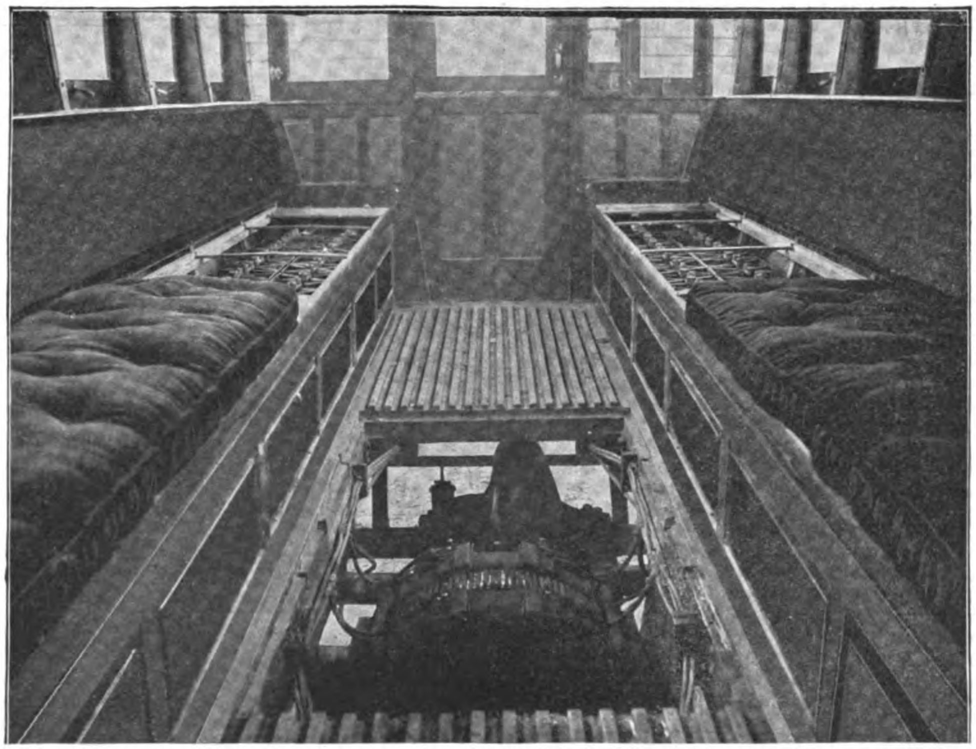


FIG. 5.—THE SILVEY STORAGE CAR.

It will be observed that the motor is placed with its armature shaft at right angles to that of the car axles, they being geared in such a way that the driving or motor shaft is geared to both axles in the proportion of 1 to 5, so that the armature makes five revolutions to one of the car axle. In the construction of the apparatus the motor proper has been placed entirely on the frame of the truck, the car axles carrying no weight except the large beveled gears which are entirely encased and run in oil. A cushioned coupling is employed between the motor shaft and the shaft carrying the small beveled gears by which the car wheels are free to move in any direction without in any way affecting the other parts; at the same time the gears are always kept in the most perfect alignment.

The result of all this arrangement is that, as the gears run in oil in perfect harmony and have no undue strain, there is practically no noise and the steepest grades can be mounted with much less power than where the car wheels are geared to separate motors. In fact, as an experiment, the truck has been made to ascend a 17½ per cent. grade, being stopped and started on this gradient without the use of sand. The entire lower half of the machine is encased in a waterproof case. The upper half of the field magnet is made removable, enabling any ordinary mechanic to rewind a section in the armature in an hour without removing it from the motor, or even so much as taking the truck from under the car body. It has been the aim to make every part so simple as to be easily accessible, easy to repair, strong, light and durable, and nearly a year's use has demonstrated, it is said, that these objects have been fully accomplished.

The vital part of the system is the battery, as upon its proper performance the economy of the system largely depends. Low internal resistance must be assured before it is possible to operate without regulating devices, which in all cases are absorbers of energy, and, in a sense, more or less responsible for lack of economy.

The aim of the constructor of this battery has not been to push the efficiency of the apparatus to the utmost limit, making it very light in weight, but rather to make an apparatus capable of withstanding almost any amount of hard usage, and at the same time a battery that could be depended upon whenever needed, and one which if handled with any degree of care at all would always do its duty. It is believed that all this has been fully accomplished, inasmuch as, although the battery has been doing constant service operating the street car for the last nine months, no such thing as a short circuit or buckled plate in the cells has ever occurred from any cause. Cells having a rated capacity of 80 amperes discharge have frequently been entirely discharged at the rate of 120 amperes and charged at the rate of 100 amperes without doing any harm, either in losing the active oxide or buckling the plates. These extreme charges are of frequent occurrence as the batteries are charged in three hours and discharged every three and one-half hours during the day, two sets of batteries being employed, one operating the car while the other is being charged.

Fig. 4 shows the battery, the hard rubber cell in which it is placed being removed in order to show its construction. The battery plate proper consists of an inoxidizable alloyed lead grating, five by seven inches square and about one eighth inch thick, 21 of which constitute a complete battery cell. The perforations in the grid are filled with superficially oxidized particles of metallic lead and oxide of lead, after which they are subjected to a pickling process which hardens the fine particles into a firm coherent mass almost as hard as a rock, and by which it becomes firmly fixed into the holes and forms a surface layer over the entire plate. The plates are now taken and assembled in proper number to constitute a complete battery, there being one more negative than positive plate, as, for instance, eleven negative and ten positive battery plates. The plates are clamped together by means of a lead screw passing through the hole in the plate, as shown in Fig. 4, nuts being placed between the plates and firmly screwed down, whereby good metallic contact is made, after which they are all welded on the surface and all soldering avoided. In case it ever becomes desirable to take the cell apart it is easily done by removing these nuts, which by turning break the welded parts. The filling for the battery plates is chemically pure lead, and has been found in practice to give a useful working output of about 20 per cent. greater efficiency than is possible with batteries employing a mechanically filled plate of lead oxide alone.

Between the sets of plates in the Silvey battery there is placed a sheet of a porous separating material, the edges of which are saturated with a preservative compound and which has been treated with acids and alkalies until it becomes practically indestructible in the electrolyte and capable of absorbing about 50 times its own weight of the acids used in the battery. The latter in fact becomes nearly a dry cell, or in other words, there is very little free liquid to become spilled. Should the rubber cell ever become broken, the liquid held in suspension in the bibulous separating material is sufficient to operate the car properly during a trip. In order to prevent a possible splash of the free liquid on top of the battery plates the cell is made very deep, the plates only filling the jar to about half its depth; and as an additional precaution a sort of wooden crate, shown in Fig. 4, is placed on top of the plates, dividing the interior of the cell into small pockets, preventing the formation of waves incident to a car in rapid motion over an uneven track.

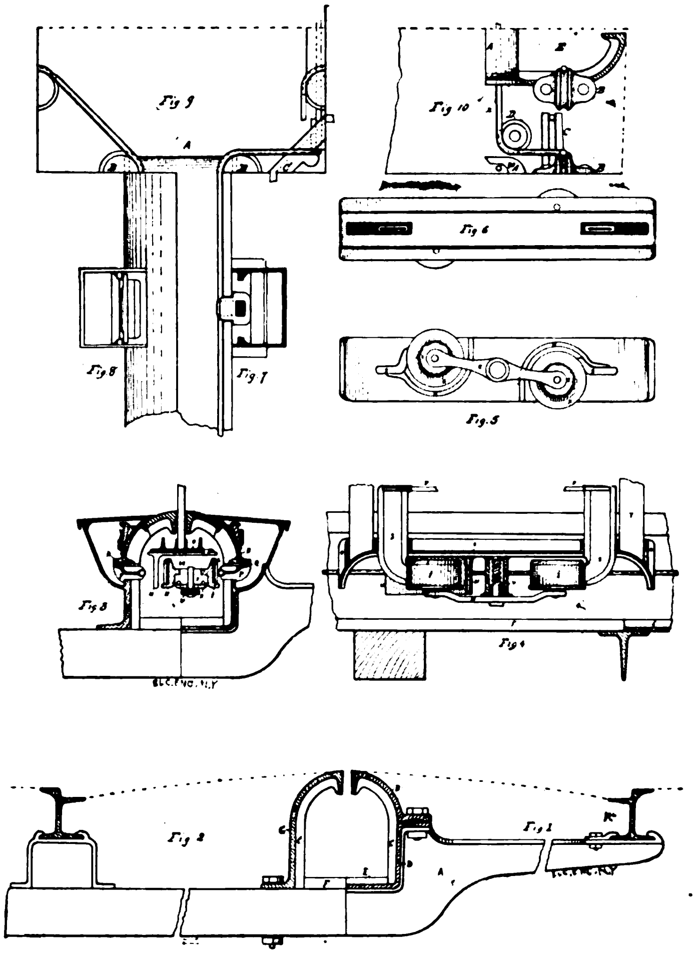
In the operation of the car 108 cells of battery are employed, each cell weighing 27 pounds, making a total weight of batteries of about 3,000 pounds, which practice has demonstrated will, in every day service, operate the car about thirty miles at each charge, running at full speed, which of course will exhaust the cells more rapidly than to run at more moderate speeds. In a test run made in November last the car made a round trip over the Third street road in Dayton, Ohio, in 35 minutes, the distance being 9 miles. This included several complete stops besides climbing two hills each about 1,500 feet long and 4½ per cent. grade, crossing 16 railroad tracks and a bridge 500 feet long, so that it is evident the car can easily make 20 to 25 miles an hour, if desired. The car has a controller on each platform containing a reversing switch and three complete changes of electrical circuits by means of which three speeds of the car are produced. The changes are accomplished entirely by commutating the batteries, no resistance of any description being employed. The first position of the lever throws the two field magnet rings into series with the armature, the batteries, of which there are 108, being thrown into two parallel circuits producing 108 volts, the car making a speed of about two miles per hour. The second position throws the two field magnet rings into parallel, the armature being in series with them, the batteries being still in parallel, producing 108 volts, at which the car will make 5 to 6 miles per hour. The third position puts the field magnet rings in parallel with the armature in series and the batteries in series, making 216 volts, at which the car will easily make 18 to 25 miles per hour. By a proper manipulation of the switch lever any intermediate speed may be produced.

The car, the interior of which is shown in Fig. 5, up to March 23, 1894, has made 6,200 car miles and neither the batteries nor the motor have ever required a single cent for repairs; in fact, no additions have thus far been made to them except a new set of carbon brushes. The total expense of every kind has been $2.50, all of which was applied to the trucks. With such a record, which is believed to be without a parallel, it is thought that this system has no equal and that a car can easily be operated at a cost not to exceed 3 cents per car mile. The batteries at present are apparently nearly as good as new and are evidently good for several thousand miles more before requiring the renewal of the positive plates. By a process, the invention of Mr. Silvey, the worn out plates are taken and the material worked over so that there is practically no waste whatever. He is now prepared to maintain the positive plates of a battery at 3 cents per mile and has found by actual test in building batteries that for every 1,620 miles at 3 cents per mile he can entirely rebuild a set of batteries of 108 cells, or for the two sets required to keep a car in constant use 3,240 miles at 3 cents per mile. When it is taken into consideration that the batteries have already made 6,200 miles and are apparently as good as new, it is evident that there is a wide margin for profit at three cents per mile and that a road operated by practical men can be easily operated for 3 cents per car mile.

One very important feature of the storage traction on this system is that the car is no heavier than the ordinary motor car, the batteries being able to give a greater return in the way of power for the size of generators than the trolley, for the reason that the charging is more regular and there are no long stretches of trolley wires and feeders to waste power, there are no leakages to destroy water and gas pipes by electrolysis, and each car, being self propelling, is a unit in itself.

THE FRANKLIN CONDUIT RAILWAY.

A railway conduit built to withstand the heavy traffic of city streets is often unnecessarily heavy and expensive for the outlying districts where travel is less frequent and lighter vehicles predominate. In order to meet satisfactorily both requirements Mr. H. H. Franklin, of 44 Clinton street, Brooklyn, N. Y., has devised the special form of conduit shown in the accompanying illustrations. The half section, Fig. 1, shows a cast iron frame which holds the rail and conduit together. This can be made very strong, and requires no more excavating than for a wooden tie. Fig. 2 shows a half section of conduit placed on the regular wooden tie, which does not require the removal of the old track, but only of the paving between the rails. The depth of the conduit is only ten inches and the casting can be light or heavy according to requirements, the interior remaining the same throughout, and every part is thoroughly insulated. It may, of course, be made for one or two trolley wires. That here illustrated shows two, a construction which the inventor considers the cheapest in the long run. If a track return is used the rails are bonded with a plate of copper at each joint for the ends of the rails to rest



Figs. 1 to 10.—Details of the Franklin Conduit Railway System.

upon and at intervals connections are made by wire to the water in the sewers.

In Fig. 1, A is a cast iron yoke which supports the side rails and conduit; B the top covering of the conduit made of rolled steel; C, C, a non-conducting lining of prepared paper pressed into shape; and E prepared cement. In Fig. 2, G is one-half of a conduit of cast iron bolted to wooden ties; F is prepared wood.

Fig. 3, is a transverse section of the two constructions in one conduit. H is the body of the trolley wheel made of porcelain, with a centre piece of brass. On the lower side is a circular groove for steel bearing balls resting on the circular disc K which is supported by the arm U. and I is a copper band around the wheel. Between the copper band and the porcelain, H, is a band of asbestos paper to prevent the heating of the porcelain. An elastic rubber band L holds the copper band on the wheel and M is a tallow cup formed in the top of the wheel.

The wheels are supported by the arm U, in the centre of which is a pin screwed to the shield O. Around this pin is a coiled spring W, which holds the trolley wheels lightly against the conducting wire X, both spring and pin being protected by a rubber tube V. The shield O, Figs. 3 and 4, protects the trolleys from mud and water. Its lower side is non-conducting and is also provided with a circular shield N, Fig. 5, which is a bottom view. In Fig. 4 this latter shield is left off to show the connections. In Fig. 5, S S, are copper conductors whose lower ends form a brush against the trolley and which have their connections at Y Y with the motor. T T, Fig. 4, are steel pieces which support the trolleys and are riveted to the shield and extend upward to the car. Fig. 6 is a top view of the trolley shield.

The conductors are supported by porcelain insulators P P, Fig. 8, and R R are hand holes affording access to the insulators. A rubber guard Q is placed over each insulator and also around the plate R to make it watertight. Fig. 7 shows a top view of the chamber and insulator, the top plate of the conduit being removed, and Fig. 8 shows a similar view with the top plate taken off of the chamber.

The drainage of the conduit runs into pits at the corners of the streets and thence into the sewer. The feeders make connections with the conductors in the pits, as shown in Fig. 9. In Fig. 10 A A A, show the lip of the conduit projecting inwardly to protect any conductors strung upon the side walls, and B B, C C and D are insulators so arranged, that, should a cross road intersect with the main line the conductor X can be depressed below the conduit.

FURTHER EXPERIMENTS WITH THE HEILMANN ELECTRIC LOCOMOTIVE.

IN our issue of Mar. 21, we gave the results obtained by the new Heilmann electric locomotive on the Eastern Railway of France. As stated in that article, the first experiments showed an economy of 20 per cent. over the usual steam locomotive.

Since then further experiments have been made with the electric locomotive to determine its fuel consumption as compared with the ordinary type of express engine. The excellent running qualities of the Heilmann locomotive were conceded by the railway engineers, but the latter have persistently claimed that the double transformation involved increased fuel consumption.

Now that the men have become accustomed to handling the engines, the last report shows a fuel consumption of 12 kilograms per kilometre for the express engines of the Eastern Railway of France, and 7 kilograms for the electric, or a gain of 42½ per cent! This result must finally set at rest the criticisms on the score of fuel consumption.

CHEAP ELECTRIC TRACTION.

THE LEHIGH VALLEY TRACTION COMPANY, which already owns 35 miles of electric road in Allentown, Pa., and vicinity, will extend its line to Easton, a distance of 15 miles. It will inaugurate a five cent fare from one end of the line to the other, a distance of 20 miles.

PERSONAL.

MR. W. S. BARSTOW, of the Brooklyn Edison Co., is now secretary of the Association of Edison Illuminating Companies, vice Mr. W. J. Jenks resigned. The Association is very fortunate in finding so good a successor to so efficient an official.

MR. JAMES H. RHOTEHAMEL, the president of the Columbia Incandescent Lamp Co., was married at Chicago on March 27 to Nancy, daughter of Mrs. Mary E. Rex. The happy couple will be at home at the Southern Hotel, St. Louis, after May 10.

MR. E. J. SPENCER has severed his connection with the General Electric Co. and has opened an office in the Security Building, St. Louis, as a consulting and contracting electrical and mechanical engineer. Mr. Spencer was for nearly nine years in the corps of Engineers of the U. S. Army, and three years on special work in the Thomson-Houston factories. He was also in charge of the whole General Electric exhibit at the World's Fair throughout 1893.

MR. H. NEWMAN LAURENCE, M.I.E.E. a well known English authority on electro-therapeutics is now in this country, with the object of lecturing upon his specialty, as well as conducting private classes. He comes with high recommendations from leading electricians in Europe.

ON CERTAIN NEW PREFIXES PROPOSED FOR PHYSICAL UNIT MAGNITUDES.

BY EDWIN J. HOUSTON, PH.D., AND A. E. KENNELLY, F.R.A.S.

The increasing extent to which scientific unit magnitudes are being used in physical research, has received a check by the inconvenient size of some of the fundamental C. G. S. units, particularly the dyne and the erg. In order to lessen this inconvenience, we would propose the following additional prefixes, which we have found convenient in our own work.

For example, instead of writing "one thousand megergs" we would suggest the term, one "begerg"; and, similarly, for the expression, "one million megergs," the term "tregerg"; and for a billion megergs, a "quegerg,"—following the analogy presented by the words million, billion, trillion and quadrillion.

Again, instead of writing, "the one thousandth of a microfarad," we would suggest the use of the term "bicrofarad," and also the "tricofarad" as the millionth of a microfarad where necessary.

The meaning of these suggested prefixes is, therefore, as follows:

Bega = 1000 million, or a billion, or 10^9.
Trega = one million million, or a trillion, or 10^{12}.
Quega = 1000 trillion, or a quadrillion, or 10^{15}.
Bicro = 1000 millionth, or 10^{-9}.
Tricro = one trillionth, or 10^{-12}.

The following applications of these prefixes will suggest their advantages.

From 1 metre = 1. metre = 100 cms.
and 1 mm. = 0.001 " = 0.1 cm.
and 1 micro-metre = 1. micron = 0.000,001 metre
= 10^{-6} metre = 10^{-4} cm.
1 bicro-metre = 1 bicron = 0.000,000,001 metre = 10^{-9} metre
= 10^{-7} cm.
1 tricro-metre = 1 tricron = 0.000,000,000,001 metre = 10^{-12} metre
= 10^{-10} cm.

The micron is of the order of the length of a light wave in the ether, and is a fundamental unit of magnitude in microscopy.

The bicron is a magnitude which will be useful in dealing with the mean free path of gaseous molecules according to the kinetic theory of gases.

The tricron is of the order of atomic dimensions according to the estimate of Kelvin.

From 1 megadyne = 10^6 dynes = approximately the earth's gravitational force on one kilogram of matter.
1 begadyne = 10^9 dynes = roughly the earth's force on one ton of matter; *i. e.* the weight of one ton.
1 tregadyne = 10^{12} dynes = roughly the weight of one thousand tons.
1 megerg = 10^6 ergs = 0.0737 foot-pound at Greenwich.
1 begerg = 10^9 ergs = 73.7 foot-pounds at Greenwich.
1 tregerg = 10^{12} ergs = 73,730 foot-pounds at Greenwich = 37 foot-tons approximately.

From 1 megohm = 10^6 ohms.
1 begohm = 10^9 ohms = 1000 megohms.
1 tregohm = 10^{12} ohms = one million megohms.
1 quegohm = 10^{15} ohms = one thousand tregohms.

A begohm is about the insulation of one mile of well insulated conductor.

A tregohm is about the resistance required to limit the deflection of a high grade mirror galvanometer under one volt to one scale division of one millimetre at one metre range. Such a galvanometer might be called a *tregohm galvanometer*.

A quegohm is the limiting resistance with one volt and unit deflection, of an extremely sensitive mirror galvanometer, which might be termed a *quegohm galvanometer*.

From 1 microfarad = 10^{-6} farad.
1 bicrofarad = 10^{-9} farad or $\frac{1}{1000}$ microfarad.

The C. G. S. electromagnetic unit of capacity being 10^9 farads is consequently a begafarad. The use of these prefixes, therefore, assigns a convenient name to the C. G. S. unit of capacity which would otherwise require a special denomination.

From 1 henry = 10^9 cms.
and 1 microhenry = 10^3 cms.
1 bicrohenry = 1 cm.

LABORATORY OF HOUSTON AND KENNELLY,
PHILADELPHIA, March 9, 1894.

HIS MOST WELCOME VISITOR.

A READER of the ELECTRICAL ENGINEER, in the island of Cuba, writes: "I send a renewal of my subscription to your *most* valuable paper, which I find it *absolutely impossible* to dispense with. It is my most welcome visitor."

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada,	per annum,	$3.00
Four or more Copies, in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies,		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

VOL. XVII. NEW YORK, APRIL 4, 1894. No. 309.

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THE CENTRAL STATION BATTERY.

SLOWLY but surely the conviction is gaining on American central station managers that there must be something more than the indulgence of a mere fad to account for the numerous storage battery stations in Europe. As evidence of this, we are glad to note and describe the starting into operation of the storage battery adjunct to the Edison Electric Illuminating Co.'s new station in Boston, as the result of Mr. C. L. Edgar's study of the subject on a recent European trip. This makes the third central station thus far equipped in the United States, and we are sanguine that with the great care bestowed upon the Boston battery installation it will give a decided impetus to this work in America. As illustrating the scope of the storage battery in connection with central stations we furnish here a table made up from the results obtained during the years 1892–1893 for the cities of Barmen, Hanover and Düsseldorf, Germany. It will be noted that although the efficiency of the battery averaged about 75 per cent., the *actual* loss involved by the employment of the batteries did not exceed 13.9 per cent. of the total electrical energy generated in any one case. We are also told that in every instance the work of the batteries in practice showed up better than the calculations upon which the station equipment was based.

Town.	Kilowatt hours generated.	Kilowatt hours charging battery.	Kilowatt hours discharging battery.	Kilowatt hours lost in battery.	Efficiency %.	Total net output in K. W. hours.	Ratio of battery output to total net output.	Ratio of accumulator loss to total net output in %.
Barmen...	144,996	59,573	43,584	16,989	71.48[1]	123,026	34.9	13.9
Hanover...	452,520	194,733	154,836	39,897	79.5	365,114	42.4	10.9
Düsseldorf	484,111	279,506	216,561	62,944	77.48	337,285	61.9	13.

1. Towards the end of 1892 this battery was replaced by a larger one.

WHAT CONSTITUTES INVENTION?

IN a suggestive paper recently read by Mr. Philip Mauro before the American Institute for Electrical Engineers that gentleman discussed the rumor that the present Commissioner of Patents had decided to change the policy which has so long obtained in the office and that the new plan was to refuse the granting of patents where the novelty is small or the exercise of invention is doubtful. Contrary to what is generally supposed to be the case, Mr. Mauro insisted that the only damage done in the past and to be feared in the future is due to the examiners, who by nature and habit are prone to take narrow and illiberal views of inventions. In answer to the argument that the liberality of the Patent Office is shown by the many instances in which patents are declared void or limited by the courts, Mr. Mauro replied that in these matters he considers the examiners better qualified to determine questions of patentability than the average Federal judge. Admitting, however, that some examiners may have erred on the side of liberality, these errors are insignificant, and of no consequence as compared with errors in the opposite direction, which may work greater hardship upon meritorious inventors. Mr. Mauro insisted, therefore, that the Patent Office practice obtaining in the past should not be changed and that the Courts are all-sufficient to determine ultimately the novelty of an invention in dispute, the mere fact that judges and examiners have sometimes differed, constituting no valid reason for a change in policy.

Touching this same subject Prof. W. A. Anthony had a pithy communication in our last issue, in which he expressed views opposed to those of Mr. Mauro. That there is considerable difference of opinion on the point under discussion not only in electrical but in legal circles is manifest and as bearing directly on this question we would refer our readers to a very significant remark contained in the opinion of Judge Coxe in the suit of the Schuyler Electric Co. *vs.* The Electrical Engineering & Equipment Co., printed in our last issue, and in which he referred to the limited degree of novelty involved in some electrical patents.

As to the share of the examiners in all this, we are able to print this week a brilliant and pithy contribution to the discussion, from Mr. Thomas Ewing, Jr., who shows how burdened the examiners have become by an increase of work out of all proportion to the increase of staff, and who, having been an examiner himself, is able to consider the question from both sides of the fence. It is obvious that if the examiners had more time and were paid to stay in the office when ripely experienced, fewer bad patents would issue and the situation would be materially relieved.

SMALL ARC LAMPS.

The editorial appearing in our issue of March 14, on the field open to the employment of small arc lamps, has found an echo in various quarters as is evidenced by the number of communications which have reached us on the subject. As might have been expected, opinions among those qualified to judge, are not yet unanimous as to the commercial availability of small arcs, but closer investigation will, we think, prove that the objections which exist to-day are such as can be removed. Among these opinions we note the one by Prof. Elihu Thomson, whose experience confirms the necessity of employing only the purest carbons in lamps of small candle power. Mr. W. S. Barstow doubts whether a 50 c. p. lamp can be commercially introduced, and that even a 125 c. p. lamp would meet with doubtful success owing to the cost of trimming; while he points out that the cost of attendance and renewal varies little between a 2,000 and a 300 c. p. arc lamp. Although this is probably perfectly correct at present, it is based on the assumption that carbons require renewal after a run of, at most, 16 hours; but recent improvements would appear to have made this necessity a thing of the past, so that, everything considered, we believe there is still considerable hope for the ultimate success of the small arc, in which view we are sustained by several of our correspondents. We are also glad to note that Prof. Thomson agrees in the belief that so far from encroaching upon the field of the incandescent lamp, the small arc will create a still further demand for lighting by that means.

IS ELECTRICAL WORK DETERIORATING?

In commenting on the subject of small arc lamps in this issue Mr. James H. Seymour, well known for his conservative views, touches upon a question which is of vital interest to the entire electrical community. Having taken the public by storm, manufacturers of electrical goods and purveyors of current have for some time, Mr. Seymour contends, shown a tendency to deterioration in their goods and in their service, respectively; and he believes that even now there is great danger arising from this cause, which, if not promptly remedied will finally lead to the forfeiture of the respect of the public for electricity, with consequent loss to the industry. The ultimate source of this evil Mr. Seymour lays to excessive competition. We agree with him in much that he says. Jerry electrical work is by no means a thing of the past, and will have to be fought against by decent people probably as long as the industry lasts, but it would be unfair not to recognize the fact that there is at the same time a decided tendency towards improvement manifested in electrical work of all kinds, due also to competition, and not a little also due to the well meant though not always intelligent efforts of the fire underwriters. We believe with Mr. Seymour that the American public is willing to pay a fair price for a thing it wants, and that the scaling of prices which leaves no profit, or which requires the substitution of an inferior article, is both foolish and pernicious in the long run.

OBITUARY.

GEORGE TICKNOR CURTIS.

The death is announced of Mr. George Ticknor Curtis, the distinguished constitutional lawyer whose name was associated with many of the patent litigations of bygone years. Mr. Curtis was a personal friend of Daniel Webster and a brother-in-law of the sculptor, Story. In addition to his legal practice, Mr. Curtis found time for a large amount of technical literary work, and for two or three politico-historical studies, including lives of Webster and Buchanan. Mr. Curtis was born in Massachusetts in 1812, educated at Harvard, and spent a large part of his life in New England, but since 1862 he has been looked upon as a New Yorker. One of his sons, Charles G. Curtis, a graduate of Columbia, is well known in electrical circles, having been one of the inventors of the early apparatus of the C. & C. (Curtis & Crocker) Electric Co. and later as the designer of the street railway motors built by the Curtis Mfg. Co.

JACOB LIVINGSTON BARCLAY.

The death of Mr. Barclay, at Pittsfield, Mass., of appendicitis, comes as a sudden and terrible surprise to his family and friends. He was of Scottish birth and 36 years of age, a most active, progressive and intelligent man. He began his electrical career as a wire salesman for Holmes, Booth & Haydens, and then went to Chicago where he assumed also the agency for the Sprague motors and railway apparatus. On the absorption of the Sprague Co. by the Edison, Mr. Barclay became identified with the Electric Merchandise Co., a pioneer concern in electric railway supplies, and with Mr. H. McL. Harding represented the Westinghouse electric railway interests in the West. These interests he devoted his energies to until about a year ago, when he took a rest. A few months ago he and Mr. Harding decided to embark with the Walker Mfg. Co. of Cleveland, in the field of heavy electrical work for railways and transmission, and as our readers know, things were going along most smoothly and favorably, offices having been fitted up in New York and Chicago, and all steps having been taken to organize a staff for production and sale of goods. His death at such a juncture is at once most saddening and bewildering and we can only extend our deepest sympathies to those in any way connected or associated with him. He leaves a wife and two young children.

MISCELLANEOUS.

THE PATENT OFFICE.[1]

BY THOMAS EWING, JR.

THE hostility of the agriculturists to the patent system has rendered almost impossible the accomplishment of any reforms which tend toward its expansion. It has proved useless to point out to them that invention of machinery used in farming and transportation has made the whole world a market for their wheat. They recall the royalties paid on driven wells and barbed wire fences, and are deaf to all appeals. Take for example the provision which limits the terms of United States patents by prior foreign patents to the same inventor upon the same invention. This clause has withstood every effort to effect its repeal. Yet it is rarely operative to curtail the periods of monopolies because of the practice that has grown up under it of issuing all patents simultaneously. And it works great injustice by enabling an unmeritorious rival to glean every sheaf and blade in the foreign patent fields while the true inventor is striving to obtain his United States Patent. But there is one reform which it is the purpose of this paper to show should stand upon a different footing. The reformation of the Patent Office, so earnestly desired by inventors, should find advocates even among those who are most bitterly hostile to the patent system. For it is demonstrable that its accomplishment will greatly advance their interest. The increase in efficiency of the Office has long interested me because I was once a member of its examining corps, and because I believe that it can be accomplished by bringing home to the public understanding the certain fact that the burdens of the patent system would thereby be greatly diminished.

There are in the patent laws of the world to-day, broadly speaking, two systems of issuing patents; (1) the British system of indiscriminate grant on mere registration, modified of late years by the extension to the public of the right to contest the grant before the patent is finally sealed; and (2) our system, which contemplates granting patents only for inventions which, by examination in our office, have been ascertained to be new and useful. About the time (1836) when our Patent Office was established, the workings of the British Office were set forth in the following vigorous paragraph in the Westminster *Review*, recounting faithfully the proceedings then necessary to obtain an English patent.

> "Behold a reference ordered as a matter of course, a report made as a matter of course, a warrant issued as a matter of course, a bill drawn as a matter of course, signed by the King as a matter of course, attested by the signet as a matter of course, confirmed by the Privy Seal as a matter of course, and at length copied and sealed by the order of the Lord Chancellor, which also is given as a matter of course. Let but the fees be paid, and, though the project were a railroad to the moon, a patent will be granted as a matter of course, without the omission of any proper solemnity."

And Dickens in his striking sketch "A Poor Man's Tale of a Patent," written about 1851, makes his inventor exclaim:

> "Too many places have been made to provide for people that never ought to have been provided for, and we have to obey forms and pay fees to support those places when we shouldn't ought. Look at the Home Secretary, the Attorney General, the Patent Office, the Engrossing Clerk, the Lord Chancellor, the Privy Seal, the Clerk of the Patents, the Lord Chancellor's Purse-bearer, the Clerk of the Hanaper, the Deputy Sealer, and the Deputy Chafe-wax. No man in England can get a patent for an India-rubber band or an iron hoop without feeing all of them. Some of them over and over again. I went through thirty-five stages. I began with the Queen upon the throne. I ended with the Deputy Chafe-wax. My opinion is that the whole gang of Hanapers and Chafe-waxes should be done away with, and that England has been chafed and waxed sufficiently."

It is not unnatural to assume in view of this record of legal flummery and extortion that our cheap and efficient system of granting patents is established mainly in the interest of patentees. It undoubtedly is greatly more beneficial to them than the British system even as now administered, where Hanapers and Chafe-waxes have been at last duly suppressed. And this not alone because it is cheaper, but from the very nature of patents. There is an erroneous impression which finds support in the phraseology of the granting clause of every patent, that it is a grant of the right to make, use and sell the invention patented. It is not. Singular as the fact may appear, and contrary to the letter of the law as it undoubtedly is, what a patent really grants is not the right to make, use and sell the invention, but merely the right of excluding others from making, using or selling it. The right of the inventor to make or use or sell his invention exists, if it exists at all, irrespective of the patent. Mr. Bell could use his telephone before he got it patented as freely as afterward, if he could make it work. What the patent gave him was the right to exclude every one else from practicing the art of electro-telephony. The patentee is not exempted by the grant of a patent from the general rule of law that a man must so use his own as not to interfere with the rights of others, and may be prevented from using his invention even by a law of one of the States, as where in 1881 in Ohio the inventor or concoctor of a medicine, for which he had a patent, was punished for administering it because he was not a duly qualified physician. But the most serious limitations on the right of an inventor to enjoy his invention arise from the operation of other patents which embrace it within the scope of their claims. Mr. J. J. Storrow, in his admirable argument before a committee of the House of Representatives in 1878, states that four-fifths of the suits respecting patents are contests between patentees. It must be clear therefore that it is generally for the interest of inventors of real merit that patents should be limited to their true scope, and litigation be curtailed as much as possible.

But the proper limitation of patents by full examination before grant is vastly more important to the general public than to the inventors. An inventor may gain by obtaining a patent that is broader than is warranted, which lapse of time, the accidents of litigation, or the ignorance of judges may enable him to sustain. But the general public is almost sure to lose by patents that are too broad. If skillfully handled they may often be made instruments of extortion without being forced to a test in the courts, and when brought to such test a patent is very difficult to defeat. It is presumed to be valid, and not only are all doubts resolved by the courts in favor of the patentee, but every advantage is given him. If the patent is weak, the patentee may perhaps, by waiting, save it from defeat through loss of damaging testimony by time's wrecking of memories, and at the end of perhaps twenty years bring suits and recover damages or profits accruing throughout the whole period; or he may select for the first attack, if preferring to sue immediately, one who is unable to make a strong defence, or one who, after making a fair show of fight, will collusively submit to a decree in consideration of a share of the spoils of the monopoly. The whole public is a party to every patent suit and is, in theory, represented by the defendant. But it is not to be expected that a defendant will conduct a burdensome and costly litigation which may end in a ruinous injunction, merely to protect the public. He considers only himself, and if it is to his interest to settle he makes the best terms he can, and the public is sacrificed. Of course the courts, in so far as they are able, punish collusion. But it is very difficult of discovery, and patent causes so abound in abstruse problems that judges usually jump at any determination of them which is acceptable to the parties. One or two favorable decisions, or the mere collection of royalties from a few infringers, secure for the patentee the right in subsequent suits to a preliminary injunction, a terrible bludgeon with which to beat down all further opposition.

Thus the patentee when he attacks the public in the courts has the advantage taken by the farmer in the fable of the bundle of sticks too strong to be broken together, but readily broken one at a time. But under our system of examination before grant the applicant meets in the Patent Office the representative and guardian of the *united* public. The Office can raise and investigate every objection to the grant, free from all the restrictions imposed by the pleadings or procedure of the courts, and uninfluenced by the fear of loss or hope of gain that influences defendants. If thoroughly organized and equipped to conduct adequate searches before the grant of patents, the Patent Office would fulfill the function which the theory of our laws requires, and would be a powerful agent for the protection of the public interest.

I am inclined to believe that we would do well to borrow from the British and German laws the practice of exposing applications to public opposition before patenting. Of course this change will never be agreed to by the inventors unless the rule above mentioned, which limits the term of United States patents by prior foreign patents, is repealed, for the change would necessitate publication before grant, which would destroy the right to patents in any foreign countries unless they were obtained before such publication. If so obtained they would, on the other hand, under our present statute, limit the term of the United States patent to that of the foreign patent having the shortest term. I do not think it would be wise to adopt the English system of public opposition without official examination, but suggest the German system of official examination followed by public opposition. What is everybody's business is nobody's business, and the importance of opposition to patents for devices that are at least commercially new may not be apparent, or those who would oppose may be conciliated. There should be a body of men charged with the duty of entering, in the public interest, just opposition based upon common knowledge, and they should be men whose skill in investigating and classifying the literature of the various arts is kept practiced by constant consideration of the merits of applications. The public opposition might be entered before the examiners themselves, after the step known, in the present practice, as the allowance of the application, with an appeal by either party, from the Examiner's decision, to a court established to administer the procedure of opposition and hear the appeals. It would be in the nature of an extension to the general public of the right of opposition now exercised in our interference proceedings, but there confined to rival inventors with contemporaneous applications. It would enable opponents to prove their objections, based often on testimony unattainable at any time by the office, and perhaps soon irretrievably lost, without being obliged to wait, it may be years, for the patentee to begin a suit. This public opposition would, moreover, subject the decisions of Examiners to immediate criticism, instead of the present tardy criticism of adjudication, and there would be brought into the Patent Office knowledge of the common practices among workmen, the rules of thumb which comprise so much of the essence of every art and are so rarely found in the literature of any art. It would give us, on such questions as, What constitutes invention? decisions in litigated cases by men who are more intimately acquainted with the capacities of practical mechanics than judges under the present system of equity suits, in which all testimony is taken before Lord High Stenographers, ever can be; and it would tend to induce uniformity in the law now administered by the courts of nine all but independent circuits. Speaking of the general plan of public opposition before grant, Gen. Samuel A. Duncan, in the third volume of the *American Social Science Journal*, says:

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[1] A paper read at a meeting of the American Association of Inventors and Manufacturers, Washington, January 16th and 17th, 1894.

> "This would be a cumbersome and expensive system and would demand for its execution a much larger force than that now employed; but if practicable it would oftentimes develop important facts not otherwise attainable by the office. The preliminary quasi-judicial test of the validity of the proposed grant would be of a summary and inexpensive character, as compared with the ordinary protracted litigation in the courts; and while it would not necessarily prevent subsequent litigation, yet doubtless a patent thus granted in the face of active partisan opposition would stand upon a much firmer basis than one granted, as now, upon *ex parte* proceedings."

The expansion of the Patent Office does not lead to extension of system, but to the limitation of patents to what the law in theory grants, viz., patents for inventions that are really new and have a utility. Every increase in its efficiency effects, by better searches and fuller consideration, a decrease in the issuance of patents that are too broad or are entirely unwarranted. For, if the Examiner by his search can find nothing to anticipate an invention, the patent is issued on the application as it is filed. But, if he finds anything that should limit the patent, the application must be modified or abandoned. It is an error to suppose that a disposition of the Examiners to favor inventors leads to inadequate searches. No man after making a search feels satisfied with the negative result of finding nothing to cite against the invention. If a complete anticipation is found, the Examiner knows that he has accomplished everything that can be accomplished. But if nothing is found he still knows full well that what he is searching for may exist. In character, industry, and ability the standard of the force is high, and the examiners, if able to do so, would make better searches, and better protect the public interest. But so far from appreciating the value to the public of the labors of the Examiners, and showing a consequent disposition to increase the efficiency of the Patent Office, the enemies of the *system* have never missed a chance to strike the *Office* a blow, and are now striving, by preventing its necessary growth, to kill it of dry rot. Its position before Congress has long been much like that in which the famous Governor Brough, of Ohio, found himself, who, when twitted about his enormous bulk, in the lines,—

"If flesh be grass as people say,
Then Johnnie Brough's a ton of hay,"

retorted that he thought he must be a ton of hay, because all the jackasses in the country were forever pulling at him.

There are in the examining corps the grade of Principal Examiner and four grades of Assistant Examiners. The salary of the Principal Examiners is fixed by law at $2,500 a year. But in the spring of 1890, when there were thirty Examiners, the House of Representatives determined to appropriate only $2,400 for each, thereby saving the government $3,000, and bringing on a debate which cost, in the salaries and expenses of the House, more than the $3,000 saved; and this has happened several times. The first Assistants are paid $1,800, the second $1,600, the third $1,400, and the fourth $1,200. All Assistants do substantially the same character of work. The corps including the Examiner of Interferences now numbers 199 men. In the year 1886 there were 192 applications filed to each man on the examining corps. In 1892 there were 205 to each man. In 1893, owing probably to the hard times, the number of applications fell off. The ratio of applications to members of the examining corps for 1893 was the same as for 1886, to-wit 192.

The ratio of Examiners to applications should steadily increase, for the labor of searches steadily increases. In the consideration of an application for a patent the main field of search for devices which may anticipate the invention is in the United States patents. The number of these patents at the end of 1886 was 355,290, and at the end of 1893, 511,743. That is, if the number of United States patents be taken as indicating the extent of the field of search, it was 44 per cent. larger in 1893 than in 1886. It is difficult to estimate accurately to what extent the labor of a search increases with expansion of the field of search, but the difficulty probably increases as rapidly as the field expands. True, this is influenced largely by classification. But the labor of classifying falls of necessity upon the examining corps, since none but experts can properly classify the literature of any art; and rules which would so restrict patents as to render them susceptible of exact classification would require such multiplication of patents as would cause confusion in business and unreasonable expense to patentees. The only system which has worked well in practice is to classify inventions according to the uses assigned. If, for instance, a centrifugal machine is devised for use in metallurgy it is classified as a metallurgical machine, and if for use in the manufacture of salt it is classified with machines for making salt. It is possible under this system that two applications describing machines identical in construction may be sent to different divisions of the Patent Office. But such cases of identity are apt to arise only when new types of machines are introduced, since with the refinement of invention the uses to which machines are to be put impose peculiarities of construction which distinguish machines of the same type found in different arts. And, furthermore, if a system of classification were adopted under which machines of like construction were all put into a distinct class together, irrespective of the uses to which they are applied, an Examiner, in order to make searches in any art, would have to be able to determine, not, as now, to what various uses a particular invention can be applied, but by what various means a particular result can be accomplished. This task would require of the mere searcher the genius of the inventor.

There is no doubt that great advantage would result from the establishment of a supplemental classification under which all patents should be grouped according to their construction rather than their use. This would effect great saving to the Examiners in the collection of cross-references for their various classes, and would secure greater certainty of a clean sweep of such cross-references.

It is however clear in theory, as it is unquestionably the fact in practice, with any practicable system of classification, that almost every search must be carried, not alone through that particular class to which the invention is assigned, but through many classes containing analogous devices. Take for instance a search to find all devices that may limit the claims upon a nut-lock. The principle involved in many nut-locks would serve equally well in a ratchet, a clutch, a feeding device, or a let-off. It may be found, for instance, in the class of ratchet screw drivers or augurs, in any one of perhaps twenty classes of electrical devices in which ratchets are used, or as an attachment to a sewing machine or a loom. This may be an extraordinary case, but there are many like it; and the overlapping of classes is constantly increasing, it being the main business of the general run of inventors to carry principles already evolved in one art into other analogous arts.

I have so far spoken only of the difficulty and labor of the search against the inventions to be patented, but fully one-third of the time of the Examiner is spent on correspondence with the applicant to reach an agreement as to the proper nature of the grant in view of the state of the art. The manuscript monthly reports of the Examiner of Textiles for the year 1892 shows that in that year his force passed to issue 606 cases. Roughly speaking about two-thirds of the cases filed are passed to issue. The Examiner probably disposed of about 900 cases. He made 3,039 rejections. The aggregate of rejections and issues is 3,645 to about 900 cases. This means that the cases came before the Examiner for consideration, on the average, four times before their form and scope were finally determined and his assent to issuance or final rejection given.

In view of the facts set forth in the foregoing discussion it is clear that Mr. Commissioner Simonds did not overstate the case when he said, in his report for 1892, "that no like number of men in the world, assembled in one body, has to perform duties as delicate and difficult as those which are performed by the examining corps of the Patent Office." So far from making overstatements, I have passed unnoticed many of the duties of the Examiners. They administer the registration of trade marks, they answer all appeals from their decisions against applications, they determine all interferences between rival applicants. And there is much valuable work which cannot be touched. The whole body of our patents ought to be accurately digested. Mr. Commissioner Simonds in 1892 asked that 32 Fourth-Assistant Examiners be appointed expressly for this work. He probably thought it useless to suggest any other plan. But it is work which each assistant should do in his own class, for he alone can have in considerable measure the knowledge necessary to determine what a digest of the patents of his class should show. The routine labors of the force should be sufficiently lightened to leave time and energy for this work. The Commissioner also asked at the same time that 16 Fourth-Assistant Examiners be added for the purpose of bringing the routine work of the corps up to date and keeping it there. What is needed is not more fourth-assistants, but more men of higher rank and better salary. Such an increase of force as Mr. Simonds vainly requested might enable the corps to catch up and keep up with current work, but only by continuing to permit the issue, in increasing numbers, of patents that should never be granted or are broader than the state of the art warrants.

Upon any fair estimate the increase in labor of properly dispatching the business of the Patent Office during the last eight years has been at least twenty-five per cent. The increase in the force during the same period has been but six per cent. Admirable administration has saved the Office from proportionate degeneracy. But the cost to the public of any degeneracy in its efficiency cannot be estimated, for no man can guess what an important but unwarranted patent may cost the public before it can be judicially declared invalid or has run its term. I do not hesitate to say that if the examining corps were doubled there would still be plenty of work for every man and the public would be the gainers. The present deplorable situation is not new. A forcible writer says, in *The Nation* for October 26, 1876,

> "The exhaustive determination of the question of novelty in every new application involves laborious and tedious search..........First-class men have not sufficient inducement to remain in the office after they have become educated to their duties, and hence the work of examination is frequently committed to inexperienced men..........As a result of all of these causes the number of patents is increasing at the rate of three hundred a week."

If this was so seventeen years ago how much truer is it now. The salaries have not been increased in forty years. The labors incident to the position have steadily increased throughout that whole period, while the inducements held out by private business to men who show themselves capable in the Patent Office are as great now as they ever were. The application of the civil service examinations in determining appointments has carried into the office boys fresh from school, and has all but excluded from the recruits men of larger experience and riper judgment who, having unfortunately forgotten how to extract a cube root, fail to qualify in arithmetic. There is of course no harm in those out of whom it is proposed to make Examiners being "caught young." But the present system, under which young men are drawn into the office to remain barely long enough to learn its rules of practice, is about as efficient in making Examiners, as the method, which, according to Gen. Sherman, was used to christianize the Indians—"lasso 'em, baptize 'em and let 'em go."

When the Constitution was in process of adoption it contained at one stage a provision for the establishment of a great National University. This was afterwards stricken out and the provision for the protection of authors and inventors inserted, apparently in its stead. It was no unworthy substitute. And if all classes could be made to see their true interest, and the Patent Office were raised to the dignity and efficiency which its great public function demands, the accumulated learning of all the arts would be classified and disseminated, carrying the seeds and fruit of thought of the world's brightest laborers into all the workshops of industry. Inventors would be instructed, stimulated and rewarded, and the public would be protected. But instead, rapid increase of business is swamping the Patent Office, and the enemies of the *system* are defeating every effort to make the *Office* an efficient public servant. Thus, without diminishing the protection afforded patentees, they are multiplying vicious patents by forcing the degeneration of our admirable system of grants after adequate examination, into the system of grants on registration in its most oppressive form. More infatuated than blind Samson, they are pulling down the temple upon their own heads, without compassing the destruction of their enemies.

"LIKE A FISH OUT OF WATER."

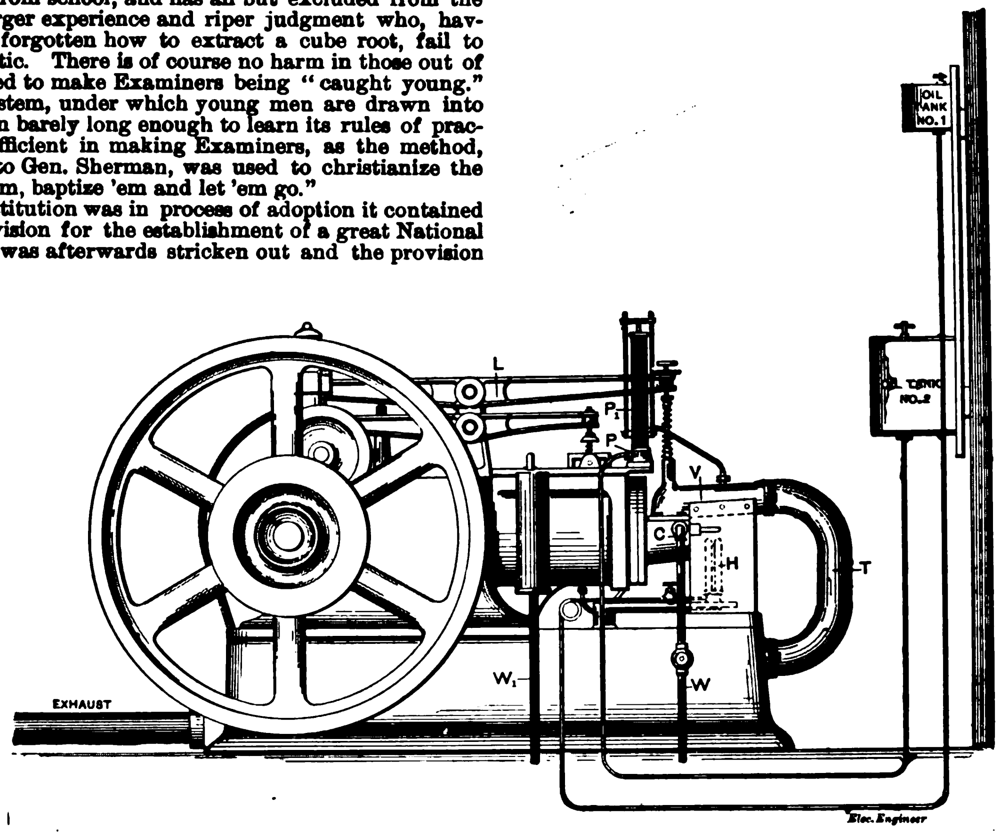
ONE of the foremost men in the Canadian electrical field, a large manufacturer as well as a central station man, writes us: "I feel like a fish out of water without a weekly perusal of your paper."

ELECTRICITY FROM KEROSENE.

BY

H. C. Cushing Jr.

ONE and two-tenths of a gallon of kerosene oil if properly used will produce 48.9 amperes at 110 volts pressure for one hour, or 80 16 c. p. lamps for the same length of time for the small cost of 8 cents, which means one-tenth of a cent an hour for each light. The wires upon which these lights are run are not directly connected to the gallon of oil, as the title of this article might imply, but are connected to an ordinary dynamo, the dynamo belted to a Saurer petroleum engine, and then the kerosene oil is given a chance by being poured into a small tank which feeds the engine at the very economical rate of 1.2 pints per horse power per hour. The writer was called upon to make a complete test of this engine, both for efficiency and safety, by the Boston Board of Fire Underwriters, with the following results:



THE SAURER PETROLEUM ENGINE FOR ELECTRIC LIGHTING.

The Saurer engine, which is built in four sizes, two, four, eight and twelve horse power, is a Swiss invention and is being manufactured by the Thomson Electric Welding Co., of Lynn, who are the sole makers in this country. One of the eight horse power type was given me to test and was run to its full capacity for five hours, using an old type Thomson-Houston dynamo as a load. After having run the engine for four hours, to note whatever heating effect there might be, the following readings were taken. The speed at no load was 350 revolutions and upon throwing on the full load instantly, the speed dropped to 340 revolutions, or only 3 per cent. When the load was constant there was no variation in speed as shown by the tachometer. In order to get the full eight horse power out of the engine the dynamo was made to carry a load of 48.9 amperes at 110 volts pressure, or 7.2 electrical horse power, the dynamos having an efficiency of 90 per cent. Just before making the test of one hour the oil was measured and at the end of the test it was found that exactly 1.2 gallons were used.

This amount for an eight horse power engine is at the rate of 1.2 pints per horse power hour. Kerosene at the rate of 6¼ cents per gallon shows the following economical results:—

Eight mechanical h. p. = 7.2 electrical h. p. (dynamo 90% eff.) 7.2 e. h. p. = 5871.2 watts. One 16 c. p. lamp = 110 volts and .61 amperes, or 67 watts. $\frac{5871.2 \text{ watts}}{67 \text{ watts}}$ = 80 16 c. p. lamps for a little less than 8 cents, or one 16 c. p. lamp one hour for one-tenth of a cent, for fuel.

Referring to the illustration of the Saurer engine the kerosene used (150° fire test) is placed in the two small tanks 1 and 2. The smaller tank 1 is for the oil used for the heater H, and is connected with it by a small pipe as shown. It is raised six or seven feet above the floor, in order that the oil may flow to the heater under slight pressure. The larger tank, 2, contains the oil used to operate the engine, and flows through piping to the pump P. This tank is fixed at such a height that no oil can rise above the middle of the stand-pipe P_1 of the pump P. By the pump the oil is driven when needed in the exact quantity required to the vaporizer V, where it is heated and vaporized by the heater H and mixed with air drawn through the tube T.

The engine is easily started by turning the fly-wheel. The forward motion of the piston draws a charge of the mixture of vaporized oil and air from the vaporizer V into the engine cylinder. The backward motion compresses this charge which is then ignited by a porcelain tube, extending from the cylinder and kept hot by the heater H. The combustion drives the piston forward after which the dead gas passes through the exhaust. The oil and air are mixed in proper proportions to insure a good combustion. The pump P is operated by the lever L, so controlled by the governor that it is only moved as the engine requires additional fuel. The engine governs so accurately that a practically constant speed is maintained under varying loads. No oil can pass the valve of the pump P except when driven by the pump. The fact that the high fire test oil is in the liquid state and is raised little, if at all, above the temperature of the room until it enters the vaporizer V of the engine, is in itself a guarantee of safety from fire or explosion. The use of the porcelain ignition tube insures a certain firing at the right time of the combustible mixture of vaporized oil and air in the cylinder of the engine, and the trouble caused by the scaling and wasting of metallic ignition tubes used in other engines is avoided.

A water jacket surrounds the engine cylinder, and a small quantity of water flows through the pipe W into this jacket and passes out through the pipe W_1, keeping the cylinder at a proper temperature. In many cases this water can be used over and over again. The engine base contains mufflers for the exhaust gas and the air inlet which reduce the noise to a minimum. All bearings are self-lubricating, special devices being attached for that purpose, rendering any attention to this detail unnecessary while the engine is in operation, and the parts are perfectly cool after a day's run. The burner H, used to heat the vaporizer and ignition tube, is of special construction, designed to give a constant, steady heat, and consume a small amount of oil.

The small quantity of oil used, as shown by my test at the beginning of this article, the ease with which the engine can be quickly started when needed, or instantly stopped, and the fact that no care is required while it is in operation, make it a very desirable and cheap motor wherever a small power is required. For portable work, saw mills, machine shops or isolated lighting plants that require not more than 120 16 c. p. lights, it is especially adapted, and considering the fact that no boiler or gas piping is required, that all expense ceases the instant the engine is shut down, and that its use has been allowed by the insurance people anywhere that an ordinary heating stove is permitted, the Saurer engine will undoubtedly be very extensively used.

PRIZE FOR INFORMATION ON WIND POWER.

THE NETHERLAND SOCIETY FOR THE PROMOTION OF INDUSTRY has offered the following prize and conditions for 1894:

The Society wants to receive papers, containing an indication of the means to obtain energy through windmills, to accumulate this energy electrically, to transmit it or to make it transportable; and desires more particularly, an answer to the following questions:

1. What is the average energy a common windmill is able to produce, per day of 24 hours, in combination with an electric accumulator; what would be the installation most suitable to this effect and what would be the cost of one horse power hour?

2. Is it possible, from an economical point of view, to apply the new aërial motors on an extensive scale for the accumulation and the utilization of this energy?

If so, what mechanical appliances would be required for this purpose?

The project of a supposed application of the system, by which a factory is provided with light and power, is wanted as an illustration.

The drawings belonging to the answers must be made on white paper (no blue prints) on a scale of ¼.

The prize offered is the Gold Medal of the Society and an award of £30.—($140.)

Answers must be sent before July 1, 1894, with the author's name in a closed envelope, to the General Secretary of the Society, F. W. van Eeden, at Haarlem, Holland. Further information about the conditions may be obtained at the same address.

LETTERS TO THE EDITOR.

SMALL ARCS AND ELECTRICAL BUSINESS METHODS.

I HAVE read with care and interest the editorial on "A Big Opening for Small Arcs" in your issue of March 14. The wonderful development of the electrical industry, in the last ten years in America, astonishes the world. People have come to believe that electricity is capable of doing almost everything for the human race, and the demand for its varied service is rapidly increasing. It is a question whether we realize the importance of this demand, and are we prepared to supply that demand in a truly commercial manner?

It is the history of all business that the better the service to the consumer, more rapidly does the business develop. In America, where there is so much business enterprise, we are inclined to believe that when an industry is developed to a point of liberal demand, then the tendency is to depreciate, instead of improving the service to the people. It is particularly so in all manufacturing business. It is important that the electrical business, as it is a new element of manufacture, *shall not* fall into the serious error of believing that as we now have it introduced, and the demand created, the public now can be served in a careless and unreliable manner? If we have reached that point it would be a sad misfortune.

The present is a good time for the literary man and the editor, who to a large extent create and educate public sentiment, to review the past business history in this country, say for twelve years. The electrical business is no exception from other branches of industry wherein an attempt has been made for every man in business to drive out every other man and thereby obtain the whole field of operation, for his special benefit. A few minutes of thoughtful consideration will lead to a realization of what that method of procedure has finally brought the business of every description throughout the United States to. There never was a better time for business men to realize the importance of sound business principles, and of serving the public with some degree of responsibility.

We should not be unmindful of the work that has been accomplished in the many years past in the electrical field by the men who have passed beyond the activities of life, and have helped lay the foundation, theoretically and practically, for those who are now actively engaged in electrical enterprise. It is true, that improvements in the arc lighting branch have not been rapid, but we must remember that it has been necessary to establish the confidence of the users or consumers of the electrical apparatus, before very great progress could be made. This is true of every branch of business on earth, and it is the foundation and the valuable thing of all business. Without confidence on the part of purchaser but little can be accomplished; therefore it has been necessary to gain the confidence of the people before much could be done in inducing them to use arc lights for interior work.

Now, the question presents itself, How well will we take care of that established confidence? If we abuse it, it will depart soon, but if we encourage it, it will develop far beyond our anticipation. There is no reason why we should not use arc lights, and they can be made at the present time, from one hundred and fifty candle power to as large an illumination as is desired, for any use whatever, and thoroughly reliable. Electric lighting in its various branches has reached the point where it is far more reliable than the daylight, for the reason that it is at our command and the people are beginning to realize that to depend entirely upon daylight, is not as advantageous as to depend entirely upon the artificial light produced by electricity at the pressing of a button or the turning of a switch. The further this question is investigated at the present day in factories, stores, offices, etc., the more we will realize the importance of electric lighting.

The question resolves itself into about three distinct, important features: Generation, channel of conveyance, and the delivery of light to the consumer. If any of the three points named are neglected, just to that extent the business will suffer. The less we attempt to make excuses for these defects, the better. It is nonsense to say that the consumer will not pay the price. They will always pay what a thing is worth and they have a right to expect that they shall be well served. The whole difficulty lies in the rotten business, methods and you as a leading electrical journal of this country, should not, and I hope you will not, hesitate to criticise severely the methods that are detrimental to the electrical industry, no matter how hard it may hit any of us in the business, as THE ELECTRICAL ENGINEER has more influence throughout the electrical industry than any other paper.

JAMES H. SEYMOUR.

NEW YORK, March 17, 1894.

THE EDISON ELECTRIC ILLUMINATING COMPANY of Brooklyn has declared a quarterly dividend of 1¼ per cent., payable April 16 to stock of March 31. This is an increase of ¼ per cent.

REPORTS OF COMPANIES.

FOURTEENTH REPORT OF THE AMERICAN BELL TELEPHONE CO.

THE 14th report of the American Bell Telephone Company covering 1893, was presented at the annual meeting last week. The operations of the Bell Company are thus stated, with comparisons, and also a condensed balance sheet: .

EARNINGS.

Year Dec. 31.	1893.	1892.	Increase.
Rental of telephones	$3.513,711	$3 303.753	$209,958
Dividends	†1,824.432	†1,422,048	402,384
Com's'n from Ex-Terr. lines	108,621	101,306	7.315
Com's'n from Teleg. b's'ness	29,193	29.417	*224
Real Estate	68,097	67.868	229
Interest	225,936	168,830	57,106
Miscellaneous	11,086	7,664	3,422
Total earnings	$5,781,077	$5,100,887	$680,190

EXPENSES.

Operating expenses	$392,770	$378,273	$14,497
Legal	114,852	87,767	27,085
Real estate	44,532	35,666	8,866
Interest and taxes	300,368	279,639	20,729
Commission	690,381	648.689	41,692
Royalty	10,000	10,000	....
Concessions	257,830	246,914	10,916
Miscellaneous	44,857	2,263	42,594
Total expenses	$1,855,591	$1,689,212	$166,379
Net earnings	$3,925.486	$3,411,675	$513,811
Surplus Jan. 1	2,151,011	2,151,011	....
Total surplus	$6.076,497	$5,562,686	$513.811
Regular dividends	2,214,156	1,927,227	286,929
Extra dividends	1,125,000	991,863	133,137
Reserve general depreciation.	450,000	400,000	50,000
Reserve depreciation instruments	136,330	92,585	43,745
Total charges	$3,925,486	$3,411,675	$513,811
Surplus Dec 31	$2,151,011	$2,151,011	....

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* Decrease. † No portion of the earnings of the Metropolitan Telephone and Telegraph Company was divided.

DEBTORS, DEC. 31.

	1893.	1892.
Telephones	$1,266,182	$1,133,900
Real estate	950,984	950,977
Stocks	37,065,131	34,120,795
Merchandise and machinery	13,317	14,441
Bills and acc'ts receivable	3,578,058	3,781,747
Cash and deposits	2,843,678	2,365,419
Total	$45,712,841	$42,367,280

CREDITORS.

Capital stock	$20,000,000	$17,500,000
Debenture bonds, 1888	2,000,000	2,000,000
Bills and acc'ts payable	1,550,596	1,334,516
Patent account (profit and loss)	10,137,493	10,169,925
Profit and loss	5,682,227	5,684,105
Reserve	4,191,018	3,557,723
Surplus	2,151,012	2,151,012
Total	$45,712,841	$42,367,280

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* Of this amount $1,200,000 is for dividends payable Jan. 15, 1894, to stockholders of record Dec. 30, 1893, against $1,050,000 Jan. 15, 1893.

The following statistics are of interest: Instruments under rental Dec. 20, 1894, 566,491, an increase of 13,771 in 12 months and of 240,817 since Dec. 20, 1884. Exchanges Jan. 1, 1894, 838, an increase of 26 in a year; branch offices, 571, an increase of 32; underground wire mileage, 120,675; increase, 30,459; submarine wire mileage, 1,673, and increase of 301; total miles of wire, 353,480; increase 45,689; total circuits, 205.891; increase 4,569; employés, 10,421; increase, 451; stations, 237,186; increase, 5,046. The daily connections in the United States are 1,871,667, or about 600,000,000 a year. The daily calls per station range from two to eighteen, and average eight, about the same as in 1892. The average cost to the subscriber for each connection is from less than 2 cents to 8½ cents. The miles of extra-territorial or toll lines Jan. 1, 1894, was 46,727, an increase of 3,833 miles, and the miles of wire 154,106, an increase of 21,104. The average daily toll connections were 34,321, or about 11,000,000 per year. The total revenue of all companies for 1893, excluding the Long Distance company, was $2,146,677. The earnings of the extra-territorial lines included above were $921,576, of which last sum the Bell company received $112,840, an increase of $8,165. The largest amount of underground wire in use in a single city is 30,397 miles in New York, 18,554 in Chicago, 8,361 in Boston, 6.972 in Brooklyn, 5,719 in Pittsburgh, 5,242 in Milwaukee, 4,409 in Detroit, 4,345 in Cincinnati, 4,314 in Baltimore and 4,047 in San Francisco. The mileage of the Long Distance company, Jan. 1, 1894, was 1.199 miles, an increase of five miles, making a total mileage of 121,930, an increase of 30,467 miles in one year. The output of telephones for the first seven months of the year was more than 25,000. This was reduced to 13,771 net by the financial panic. The same cause checked the increasing tendency of telephonic connections. At the close of this year more than one-third of the exchange wire mileage was underground. The metallic service subscribers increased from 23,053 to 37,648.

There have been added to the Long-Distance system during the year 423 miles of pole line, 9,934 miles of wire, and eight new offices have been opened, making in operation on Jan. 1, 1894, 3,695 miles of poles and 63,529 miles of wire. There are 124 offices under its immediate operation. The larger cities to which the lines were extended, and in which service was opened during the year, are Detroit, Cleveland, Cincinnati, Dayton and Indianapolis. The Long Distance lines now reach and connect the exchanges of 26 companies, licensees. The use of the lines steadily increases, and the number of connections made shows a very satisfactory increase in the past year, over 1892.

"The telephone companies operating under license from the Bell company have, during the past nine years, 1885–1893, expended $42,000,000, within a few thousand, upon the extension and betterment of their plant. The larger items are in round numbers: Overhead and exchange, $12,000,000; subways and cables, $14,500,000; buildings, $6,000,000; toll lines, $9,000,000. Previously to that period the construction account stood at the sum of $31,000,000, a total, that is, with the expenditures since 1885, of $73,000,000. In the earlier years, undoubtedly, mistakes due to the newness of the work were made, but in addition to ample allowances made for many years for maintenance and reconstruction there has been written off on account of construction a sum rising $4,000,000."

The report says further: "The general system of the operating companies throughout the country has been to charge the subscriber a fixed sum for exchange service, graduated according to the class of equipment which he selects, and leaving him free to use the service as much or as little as he chooses. On the whole, this plan appears to have worked to the satisfaction of subscribers, and in a measure distributes equitably the charge with the public pays for telephone service, since in the smaller exchanges, where the average use is the least, the charges are correspondingly small, while in the great cities, where of necessity the rates are highest, the average use is also greatest. It is by no means certain, however, that, in time to come, the companies and their patrons may not find a system of tariff rates, that is, the charging the subscriber according to the number of times his telephone is used, more equitable than the present system of uniform charges. Some experiments are in hand to see if in the great cities the case of those who want only a limited use of the telephone at a less rate than is fixed for an unlimited use can be met."

The need of more capital to extend and perfect the service is dwelt upon, and it is remarked that the expenditure upon long distance lines alone already amounts to $7,000,000. It is stated that the suit of the United States to annul the Berliner patent will be argued in June. The Long Distance company had invested up to Dec. 31, 1893, in line construction, equipment and supplies, $6,433,149. The company shows an increase in its gross earnings from that source in 1893 over 1892 of something like 38 per cent., the amount for 1893, gross being $892,361, against $643,436 in 1892 and $437,828 in 1891.

LEGAL NOTES.

THE ADAMS ELECTRIC RAILWAY LITIGATION.

JUDGE HALLETT will hear the case of the Adams Electric Co. against the Lindell Railway Co. in St. Louis, on April 20. The suit involves the application of the motor under the car, with reference to the axles, and has already been noted in these columns. (ELECTRICAL ENGINEER, April 8, 1891, p. 428). The Adams patents are 300,827 and 300,828.

STREET RAILWAY APPARATUS OF THE WALKER MANUFACTURING CO.

The Walker Manufacturing Company which has, for many years, enjoyed the reputation of being without an equal in the construction of cable railway equipments, power transmission plants, and all classes of very large machinery, has now added to its extensive business an electrical department. The company now enters the field, ready to supply electric generators for both direct and alternating currents, of any capacity, from 150 to 5,000 horse-power, with an electromotive force varying from 500 to 10,000 volts; and a complete line of electric motors for both direct and alternating current work.

These new machines, both generators and motors, are constructed for street railway use, ordinary power transmission, mining, and a special line in which they anticipate large developments in the near future, extra large alternating machines for long-distance transmission of power. Street railway companies throughout the world, who are so well acquainted with the excellent work uniformly executed by this firm, will need but the assurance that special attention has been given to the peculiar requirements of street railway engineering to insure them that the highest degree of excellence, in both mechanical and electrical construction, will be attained.

THE GENERATOR.

The generator for street railway and direct current power transmission, shown in Fig. 1, is of 250 horse-power, of the well-known four-pole type, slow speed. The frame is cast in one piece with three bearings, which are of the ball and socket self-oiling type. The field magnets are of wrought-iron and are wound with enough copper to allow them to run perfectly cold. The armature is series wound and insulated entirely with mica. With these two-path windings—the only kind used by this company—there are no unbalanced armatures, no sparking, and no heating. The windings are entirely below the surface of the armature, which is iron-clad, with no binding wires. There are no joints in the windings, except where the wires connect with the commutator bars, and the insulation throughout the entire machine is sufficient to withstand at least ten times its normal requirements. The armature and commutator are thoroughly ventilated, as a current of cool air passes all through the interior of the machine. The commutator is very large and runs cold in regular operation. The small machines of this type are belted machines, and the larger ones are usually built on the engine shaft.

STREET CAR MOTOR.

Experience has taught street railway men that the greatest cost in operating roads by electric motors has been for repairs made necessary by the rapid deterioration of the track and rail-joints. The only way to correct this evil is to entirely disconnect the motor itself from iron to iron contact with the axle and prevent not only the hammer blow due to the weight of the motor but the inertia blow due to the unyielding mass of the motor. Attempts have been made to accomplish this by suspending the motor at or near the centre of gravity. This eliminates the weight, but not the inertia blow, which is the most serious. This has forced those interested to the conclusion that the perfect motor must weigh as little as possible, be extremely strong in mechanical construction, work to 25 horse-power without heating, and not be in any way attached to the axle and wheels, except through springs which will do away with the hammering of the track to the greatest possible extent. This method of suspension gives the freedom of movement necessary for the removal of strain in rounding curves.

The railway motor being built by the Walker Manufacturing Company combines these suggestions of practical experience. It is a four-pole steel motor, weighing 1,200 pounds, has an easy capacity of 25 h. p., will run at any speed up to 25 miles an hour, is controlled by a series-parallel controller, of great simplicity and is not attached to the axle in any way, except through yielding supports.

The accompanying illustration, Fig. 2, shows the general form of

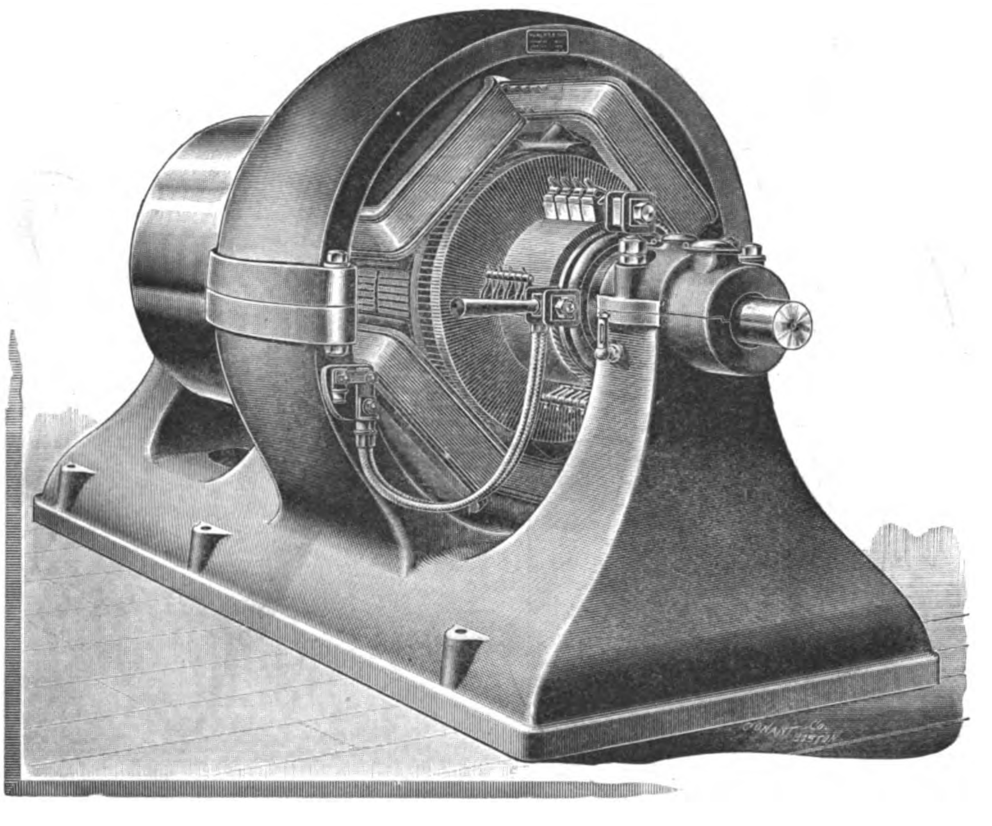


Fig. 1.—Walker Manufacturing Co.'s Street Railway Generator.

The plant of the Walker Manufacturing Company is one of the largest and most complete in the country, and is modern in all its equipment. The buildings cover about 250,000 square feet of ground, are constructed of brick, iron and glass, and are situated on the shores of Lake Erie, at Cleveland, O. The machine shop consists of three long bays, each containing a 30-ton traveling crane, which moves through its entire length. Iron galleries at either end are fitted up as winding rooms and for the manufacture of insulating materials.

The testing room is equipped with switch-boards and resistances for testing generators, brakes for testing motors, and a 1,000 horse-power engine will be erected immediately for testing the large multipolar direct coupled generators. The tracks of the L. S. & M. S. R. R. enter the testing room below the floor level, and all machines can be lifted by the large cranes from the testing racks directly to the cars.

The pattern shops occupy a large two-story building completely fitted up with modern wood-working machinery. Two large foundries occupy another building, and are perfect in their equipment. They contain four large cupolas, spacious core ovens, and numerous traveling cranes, from five to thirty tons capacity each. Fifty tons of iron can be poured at once into a single mold, which enables the company to cast their large machines in fewer parts, thereby attaining greater rigidity.

the motor, mounted upon 30-inch wheels and ordinary truck, portions of the truck being cut away to enable the motor to be more readily seen. The motor is entirely water and dust tight, the only opening being the lid over the commutator, which enables the two brushes to be easily reached. The frame is in two parts and made of steel. The gear housing and commutator lid are of malleable iron. Both gears and pinions are of steel. The shaft is large, being 3½ inches in diameter and 2½ inches in the bearings. The bearings are very long and arranged for thorough lubrication with grease. The efficiency of the motor is 90 per cent.

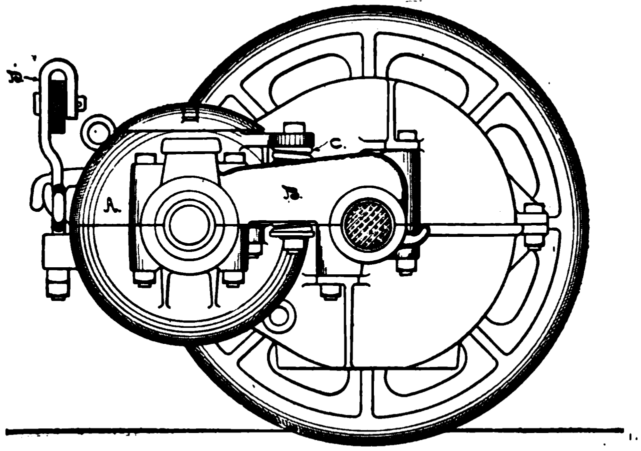


Fig. 3.—Method of Motor Suspension.

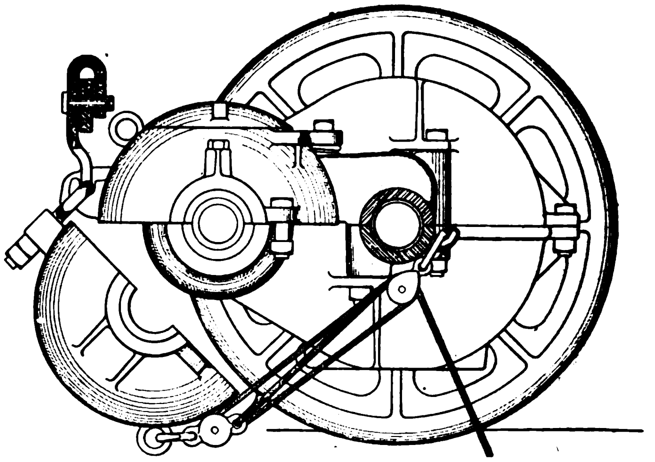


Fig. 4.

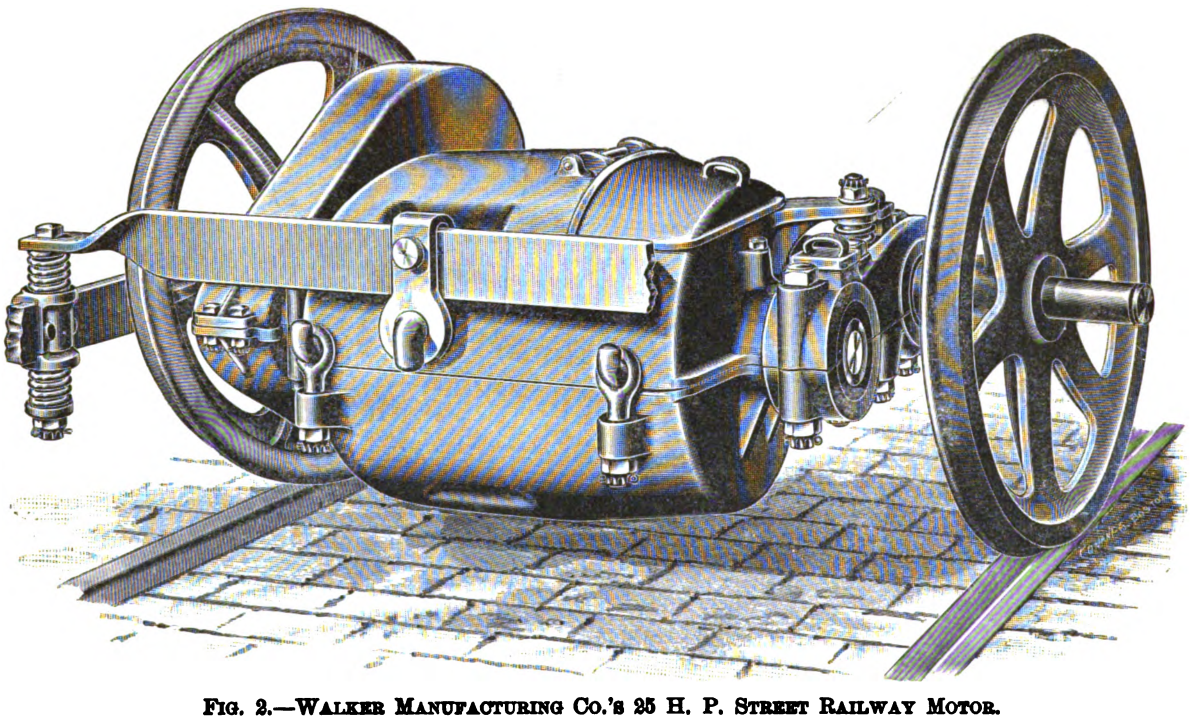


Fig. 2.—Walker Manufacturing Co.'s 25 H. P. Street Railway Motor.

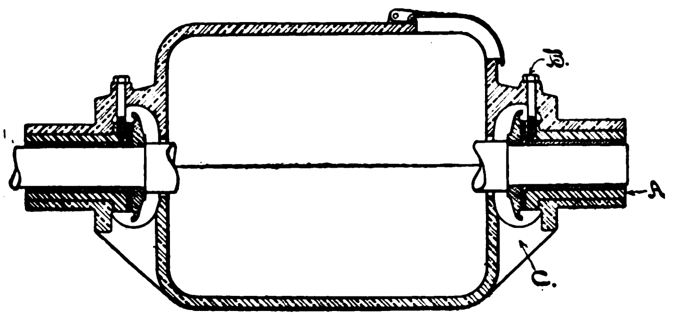


Fig. 5.

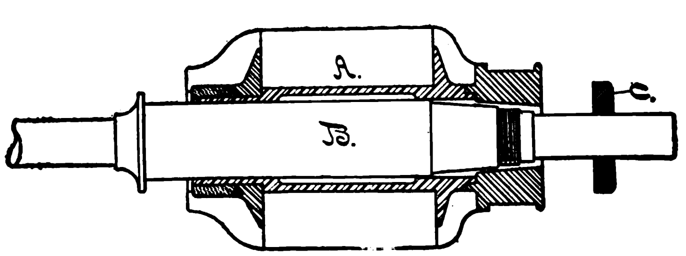


Fig. 6.

Fig. 3 shows an end elevation of the motor with one wheel taken away, showing the flexible support. B is a cast-iron U-shaped frame, the rounded end being journaled on the car-axle in the ordinary way. Swinging freely between the arms of this "U" is the motor A trunnioned by its bearings, but not touching the axle. The motor is then supported at the rear by spiral springs, C, between lugs on the frame and the arms of the "U," and the front end is supported by a swinging arm from the ordinary spring truck bar D. It can be seen that, with this suspension, the motor rides freely on springs, readily adjusting itself to varying conditions, without bringing a strain or shock on any part. The gear centres are always maintained because of the U-shaped frame.

Fig. 4 shows how the lower half of the frame is made to swing down, while the armature remains in place, one man being able to let it down and replace after inspection and cleaning. The armature may be removed, if desired, from below; or, if the motor should not be over a pit, the upper half may be swung up and the armature removed from above. By referring to the figures it will be seen that all the bearing caps come off from below, and all the bolts pass down from above; and should a nut come off, no part of the motor can fall. The bolts are not made to take the weight of the motor, and the nuts are all locked with pins.

The bearings are entirely outside of the motor casing or frame, as shown in Fig. 5. They are solid shells A filled with the best babbitt and are supported by the bolt B. The grease, which comes out between the end of the thrust collar and the inner end of the bearing, falls to the ground through the opening C, which is 4 inches x 2½ inches, and cannot be clogged. Hence no grease can get into the motor.

Fig. 6 shows a section of the armature, the core A of which is built on a separate sleeve, which receives the shaft B. This shaft, when worn out, can be replaced by removing the nut C, drawing out the shaft and inserting a new one, thus saving the expense of tearing the armature down and rebuilding, as not even a wire connection is disturbed.

The commutator is on a tapered portion of the shaft, the same as the pinion, and can be more easily drawn off for refilling. Both commutator and pinion are held in place by nuts properly locked by an ingenious lock-washer.

Being flexibly supported, it will remove all trouble with rail-joints, as in practice the motor runs as quietly as the old horse car. Not even the gear noise is heard, as the gears are enclosed in air-tight housings and run in oil. The excellent workmanship, for which the Walker Company is famous, tells greatly in this class of machinery.

The 35 H. P. motor for heavy work weighs 2,500 pounds. This motor is intended for heavy street railway work, where very large cars or trains of cars are used. It is made of cast-iron, and has an efficiency of nearly 90 per cent. It is built on the same general type as the steel motor, but is not spring mounted, being journaled on the axle like all other makes. This motor is exceedingly small and light for its output. It will operate on 30-inch wheels with plenty of clearance. The designs are already completed for large motors to operate elevated trains, or suburban and interurban railways which will be run at high rates of speed.

DIVISIONAL PATENTS.

BY EDWARD P. THOMPSON, M. E.

The last Supreme Court decision and your able editorial regarding it, emphasize sufficiently the necessity of skillful management of divisional patents. In brief, I may mention that the gist of both the decision and editorial is to the effect that it is dangerous to divide applications. Permit me to present a few points concerning under what circumstances it is dangerous, and when it would be still more dangerous to go to the other extreme. This matter of the management of the intricacies of the patent laws and decisions is comparable to that of electrical principles and laws. For thorough understanding, all sides of the question must be viewed, and in order that inventors may not think that the decision is apt to undermine the patent system, and in order that they may have some detail intelligence on the surrounding laws before they permit a fraudulent attorney to do what your editorial suggests they might do, I have attempted to unravel the apparently intricate relations existing among the patent laws and decisions, and to present the result so that inventors may easily grasp the idea, I think, and get the gist of the law, but at the same time I do not guarantee accuracy equal to that of the long and involved sentences found in patent law books.

1.—It is not only an axiom, but the statement of law, that one patent cannot protect two or more inventions, and that two or more patents cannot protect one invention.

2.—If an invention must be divided into two or more parts, danger is usually removed by describing only what is claimed in the respective applications.

3.—If two or more inventions are put into one application, the rules of the office forbid adjudication until the inventor chooses which he will retain. If the Examiner lets them go through inadvertently or otherwise, the patent may stand void as to one of them at least.

4.—Each patent may rightly contain one set of claims on the broad idea and one set on one way of carrying out the idea; but not upon a second or third way. Example: It may contain broad claims covering a carbon transmitter and another set on a particular mechanical construction, but not on two distinct mechanical structures. A development of this principle may result in the grant of a hundred or more valid claims in one patent where the invention is upon a single intricate machine. The Mergenthaler typesetting patents had an average of seventy-five claims per patent.

5.—If an application describes two inventions and claims are permitted to cover but one of them, the other should be withdrawn, whether or not a subsequent application for a patent upon it is contemplated.

6.—If two pending applications both show, but claim, respectively, only one invention, they should contain cross-references disclosing this fact.

7.—Inventions are not only divisible from a technical point of view, but sometimes as to method or process, machine or apparatus, and substance or product. The laws regarding these are too intricate to disclose their various phases here; but the inventor should have this general information.

The editorial refers to fraudulent attorneys dividing applications into many in order to get more money. Worse than this is the ignorant or incompetent attorney, for the latter will make serious mistakes, whereas the fraudulent attorney may get money without injuring the inventor's patent rights. Worse than all is the cheap attorney, who is generally a little fraudulent and a little incompetent. To guard against these in the respect under consideration, the points above are given so that the inventor may manage his incompetent or fraudulent or cheap attorney instead of being managed by him.

I am not by any means endorsing the patent system as free from injustice to inventors. For example, in the matter of the patent pronounced void by the Supreme Court which decided according to the fundamental law,—the law itself was unjust in not permitting the second patent to be valid as long as the first and to expire with it. So in reissues, an inventor ought to be permitted to revise his claims and add others to the same extent as when pending, but the fact is that he is unjustly restricted, and if his first attorney failed to do his duty he stands little chance of securing a remedy. In spite of some fundamental injustices to the inventor, most of them can be forestalled by, at the proper time, *conforming to the conditions* and paying an expert attorney for the trouble of doing this for him.

SHORT AND BRUSH ANNUAL MEETINGS.

The annual meeting of the Short Electric Railway Company was held March 27th. The old board of directors were re-elected. The following officers were elected: B. F. Miles, President; Bethune Duffield, Detroit, Mich., Secretary and Treasurer; S. M. Hamill, General Manager.

The following is from the *Cleveland Leader*, of March 27:—

"The Brush Electric Company held its annual meeting yesterday afternoon, at the office, on Belden Street. The officers' reports indicated a prosperous business, despite the financial conditions that have existed. The organization for the ensuing year is unchanged with one exception, the election of Mr. S. M. Hamill as second vice-president. He will also retain the managership of the works. The other officers elected are: president, W. H. Lawrence; first vice-president, C. A. Coffin; treasurer, B. F. Miles; general counsel, W. B. Bolton; secretary, A. H. Hough; ass't general manager, L. H. Rogers; superintendent, C. W. Phipps; ass't superintendent, Charles N. Black."

THE BALL & WOOD RECEPTION.

At the invitation of the Ball & Wood Co., a large number of engineers and others visited their works at Elizabethport, N. J., on Saturday, March 31, to inspect a new vertical engine just completed for the Chicago Edison Company. The visitors were received by Messrs. Ball, Wood and Vincent, at whose direction the engine was put through its paces, and by whom its novel features were explained.

During the reception the electric crane picked up a horizontal engine and playfully carried it around the shop over people's heads. After the inspection of the well equipped works a luncheon was served and the interesting and exceedingly pleasant afternoon was brought to a close. The company's works are very conveniently situated, are furnished with the most approved apparatus and will well repay a visit.

"IDEAL" WIRE UNDER THE OZONE TEST.

The Phillips Insulated Wire Co. have received the following report from Dr. Henry Morton:—

STEVENS INSTITUTE OF TECHNOLOGY.

HOBOKEN, N. J., March 17th, 1894.

PHILLIPS INSULATED WIRE COMPANY,
39 and 41 Cortlandt Street, N. Y. City.

Gentlemen:—The sample of "Ideal" Insulated Wire received from you on the 8th, has been submitted to the "ozone test" which indicates within a brief period the resisting power of such insulation to atmospheric influences. This sample of wire shows no injury whatever by ozone and may therefore be regarded as of the highest quality, so far as its resistance to atmospheric influences is concerned.

Yours, etc.,
(Signed) HENRY MORTON.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 20, 1894.

Alarms and Signals :—

Police Signal, M. J. Burns, Lowell, Mass., 516,641. Filed Oct. 26, 1893.

Annunciator, C. A. McCordy, Fulton, N. Y., 516,708. Filed June 28, 1893.

A thermostat actuated by the fusing of an alloy.

Burglar Alarm. W. Ritzmann, Chicago, Ill., 516,771. Filed June 12, 1893.

Railway Signaling and Switching Apparatus, J. D. Taylor, Chillicothe, Ohio, 516,903. Filed Dec. 14, 1892.

Distribution :—

Regulation for Multiphase Systems, L. Bell, Boston, Mass., 516,796. Filed June 15, 1893

The method consists in artificially raising the resistance of the lower resistance line to that of the higher resistance line.

System of Electrical Distribution, E. W. Rice, Jr., Swampscott, Mass., 516,885. Filed Mch. 6, 1893.

The method consists in generating current whose potential increases at a predetermined rate with increased load, and currents whose potential increases at a greater rate with increase of load, and conveying all the currents to the work circuit through feeders proportioned to the character of the supplied current.

System of Electrical Distribution, E. W. Rice, Jr., Swampscott, Mass., 516,886. Filed May 5, 1893.

Employs lines leading from a source of alternating or polyphase currents to a point of distribution, and means adapted to commute the currents and deliver them to mains feeding translating devices by the three wire or series multiple system.

Regulation of Alternating Currents, E. Thomson, Swampscott, Mass., 516,846. Filed June 9, 1891.

Claim 7 follows :

The combination in a regulating transformer of the fixed coil, the partly counterbalanced movable coil, and one of said coils being in the main and the other in the work circuit.

Means for Regulating Alternating Currents, E. Thomson, Swampscott, Mass., 516,847. Filed July 1, 1891.

Employs mutually inductive coils one or both being vertically movable and suspended so as to be partly counterbalanced and subject to a constant gravitating force.

Electrical Transformer, E. Thomson, Swampscott, Mass., 516,850. Filed June 28, 1893.

Claim 1 follows :

A transformer comprising primary and secondary coils, a common iron core therefor and a casing containing the coils and located between the coils and the core.

Dynamos and Motors :—

Automatic Speed Regulator for Electric Motors, W. Hochhausen, Brooklyn, N. Y., 516,651. Filed Nov. 26, 1889.

Employs two sets of switch contact blocks mounted on field poles and connected respectively with the section of the field magnet coils, and a reciprocatory switch rod having spring contacts forming connections with the switch blocks and actuated by a ball governor.

Commutator, E. R. Francis, Minneapolis, Minn., 516,783. Filed May 18, 1893.

Employs alternate terminal plates with interlocking segment stubs and alternate contact segments removably secured to the stubs.

Electric Motor, P. Wuest, Philadelphia, Pa., 516,784. Filed May 16, 1892.

A small motor especially designed for fans, etc., and so arranged that it may readily be taken apart.

Dynamo Electric Machine or Motor, N. C. Bassett, Lynn, Mass., 516,792. Filed Aug. 31, 1893.

Claim 1 follows :

In a dynamo electric machine, a field magnet frame substantially rectangular in longitudinal elevation, and composed of two parts united on a diagonal of said rectangle.

Armature for Dynamo Electric Machines, L. Bell, Boston, Mass., 516,794. Filed Mch. 17, 1893.

An armature for dynamo electric machines provided with laminated teeth, the laminæ arranged in groups separated by ventilating spaces.

Armature for Induction Motors, L. Bell, Boston, Mass., 516,795. Filed April 3, 1893.

Comprises a core with copper bars extending longitudinally along its surface and a metal disc of relatively high resistance to which the bars are attached.

Coil for Dynamo Electric Machines, L. Bell, Boston, Mass., 516,797. Filed Nov. 13. 1893.

Method of Transmission of Electricity, J. P. B. Fiske, Lynn, Mass., 516,804. Filed May 3, 1893.

A method of regulating the speed of a series motor which consists in varying the strength of the field of the generator supplying current.

Transmission of Electricity, J. P. B. Fiske, 516,805. Filed May 3, 1893.

Similar in its object to No. 516,804.

Motor Armature, J. C. Henry, Westfield, N. J., 516,807. Filed Aug. 25, 1892.

Claim 5 follows :

An armature whose coils each have an uninsulated portion bearing directly against a resilient commutator bar.

Electric Motor, W. H. Knight, Lynn, Mass., 516,818. Filed Sept. 15, 1893.

Claim 2 follows :

In a series wound motor, a differential shunt winding connected to its armature terminals adapted to respond to an increased speed of the armature.

Commutator Connection, C. A. Lieb, New York, 516,827. Filed July 18, 1893.

Comprises a slotted segment and a connector having elastic sides wedged into the slot.

Starting and Controlling Device for Electric Motors, J. W. Moore, Boston, Mass., 516,831. Filed Nov. 25, 1893.

Especially adapted to electric elevators.

Series Parallel Controller, E. D. Priest, Lynn, Mass., 516,834. Filed Dec. 1, 1893.

The invention consists in the method of changing three or more motors from series to parallel connection by shunting one motor, disconnecting it from the series and connecting it in parallel with another but in series with the remaining motors, and afterwards successively shunting the remaining motors, respectively disconnecting them from the series and bringing them into parallel with those already in parallel.

Armature for Dynamo Electric Machines, E. W. Rice, Jr., Lynn, Mass, 516,837. Filed Nov. 16, 1893.

Employs a core having transverse undercut notches, separately wound coils inserted in the notches and keys holding the coils in place.

Electrical Hoisting Apparatus, H. C. Spaulding, Boston, Mass., 516,843. Filed Feb. 12, 1890.

Employs radial field magnets on opposite sides of the armature projecting from the drum and having the latter for their yoke, and an armature concentric with the drum and geared thereto.

Method of Constructing Commutators for Dynamos or Motors, E. Thomson, Swampscott, Mass., 516,845. Filed Jan. 24, 1891.

The method consists in arranging the insulating division strips in a mold and casting the metal of the commutator around or between such strips.

Armature Winding, E. Thomson, Swampscott, Mass., 516,848. Filed Nov. 16, 1892.

Alternating Current Electric Motor, E. Thomson, Swampscott, Mass., 516,849. Filed June 17, 1893.

Claim 1 follows :—

The method of operating an induction motor for alternating currents, which consists in partly closing the armature coils as local circuits at starting and gradually increasing the short circuiting as the motor takes speed.

Commutator Connector, O. N. Turner, Lynn, Mass., 516,853. Filed June 14, 1893.

Electric Motor, C. J. Coleman, Chicago, Ill., 516,916. Filed Jan. 21, 1893.

Claim 1 follows :

A motor having its field and armature adapted to rotate in opposite direction, and gearing connections of a differential nature between each of the same and the driven shaft.

Electric Motor, C. J. Coleman, Chicago, Ill., 516,917. Filed Jan. 21, 1893.

Similar to No. 516,916.

Electric Elevator, R. Watson, Washington, D. D., 516,956 Filed Nov. 13, 1693.

Galvanic and Thermo-Electric Batteries :—

Gravity Battery, L. F. Lary, Pottersburg, Ohio, 516,653. Filed May 23, 1893.

Employs a copper electrode formed by bending a sheet of copper into cone shape to serve as a receptacle for the excitant.

Lamps and Appurtenances :—

Incandescent Lamp, G. C. Swan, Brockton, Mass., 516,689. Filed Dec. 30, 1893.

Employs a flat metallic disc fused to the inner surface of the neck of the bulb ; the tube containing the leading-in wires being fused to the edge of a hole through the disc.

Incandescent Lamp and Method of Manufacturing Same, H. D. Burnett, Lynn, Mass., & S. E. Doane, Swampscott, Mass., 516,800. Filed Mch. 17, 1893.

The method consists in placing the leading-in wires between an inner and outer tube, softening the ends of said tubes to seal the wires, sealing the outer tube to the neck of the lamp, exhausting the lamp by means of the inner tube, and then sealing the inner tube.

Incandescent Electric Lamp, E. R. Knowles, Middletown, Conn., 516,819. Filed Dec. 9, 1892.

Relates especially to the construction of the keyless socket.

Socket for Incandescent Electric Lamps, E R. Knowles, Middletown, Conn., 516,820. Filed Dec. 9, 1892.

Electric Search Light, E. R. Knowles, Middletown, Conn., 516,821. Filed Jan. 9, 1893.

Alternating Electric Arc Lamp, E. R. Knowles, Middletown, Conn., 516,822. Filed Jan. 9, 1893.

Claim 1 follows :

In an arc lamp, the combination with a carbon holder having a cross bar, of a feed rack having a traverse foot, and a plate of slate interposed between them.

Electric Signal Lantern, E. R. Knowles, Middletown, Conn., 516,894. Filed April 17, 1893.

Claim 1 follows :

An electric signal lantern, comprising two cylindrical lenses, a diaphragm between them, electric lamps supported on opposite sides of said diaphragm, two heads, and means for clamping the parts together.

Electric Arc Lamp, E. R. Knowles, Middletown, Conn. & E. H. Park, Milbury, Mass., 516,825. Filed May 25, 1893.

Claim 1 follows :

In a horizontal arc lamp, the combination with a bed-plate, of contact-strips fastened thereto, ways supported thereon, carbon holders sliding on said ways, and jointed arms connecting said carbon holders with said strips.

Electric Arc Lamp, E. R. Knowles, Middletown, Conn., 516,896. Filed July 17, 1893.

A focusing lamp especially adapted to search lights.

Lamp Socket, A. Swan, Schenectady, N. Y., 516,544. Filed April 3, 1893.

A socket moulded in a single piece and having the contact portion and the threaded tube for the lamp moulded in the body of the socket.

Incandescent Lamp, R. Langhans, Berlin, Germany, 516,892. Filed April 18, 1892.

Employs leading-in wires sealed into the bulb and consisting of an alloy of one or more the magnetizable metals with antimony and a coating of platinum.

Extension Electric Chandelier, A. McLean, Ansonia, Conn., 516,009. Filed Aug. 7, 1893.

Measurement :—

Electrical Measuring Instrument, E. R. Knowles & L. T. Robinson, Middletown, Conn., 516,828. Filed Feb. 25, 1893.

Claim 3 follows :—

An ammeter comprising two or more magnetic needles, one of which is given a lead over the other or others.

Means for Measuring Electric Currents, L. T. Robinson, Middletown, Conn., 516,839. Filed Aug. 24, 1893.

Claim 1 follows :—

The combination with a dark box of a reflecting galvanometer at one end a transparent scale at the other end and a lamp.

Electrical Measuring Instrument, E. G. Willyoung, Philadelphia, Pa., 516,855. Filed June 23, 1893.

Miscellaneous :—

Electric Device for Pumping Oil Wells, H. F. Waite, New York, 515,713. Filed Sept. 28, 1893.

Electric Appliance for Horses, G. R. King, Dallas, Texas, 516,740. Filed Mch 18, 1893.

Cooling Electric Apparatus, W. S. Moody, Lynn, Mass., 516,829. Filed July 1, 1893.

Claim 1 follows :—

The method of cooling electric apparatus, which consists in supplying to such apparatus a flow of cooling fluid proportioned to the current passing therein.

Electrically Operating Pump, C. Robinson, Lynn, Mass., 516,840. Filed Oct. 11, 1893.

Switchboard, E. F. Frost, Washington, D. C., 516,862. Filed May 31, 1893.

Consists of a number of movable levers hinged at their edges and having attached points for the reception of conductors.

Electric Cigar Lighter, J. Sachs, New York, 516,878. Filed Feb. 2, 1893.

Mode of Producing Nitric Acid and Metals from Nitrates, J. D. Darling, Philadelphia, Pa., 516,001. Filed Aug. 21, 1893.

Railways and Appliances :—

Electric Railway System, E. Thomson, Swampscott, Mass., 516,666. Filed May 29, 1891.

Claim 1 follows :—

The combination with the vehicle electrically propelled along a line of way, and having definite stopping and starting points thereon, of one or more conductors at such points making connection with the electric motor on said vehicle, and an energy storage device in connection with said conductors.

Block System for Electric Railways, J. W. Gibboney, Lynn, Mass., 516,806. Filed Oct. 12, 1893.

Employs a trolley line divided into sections and means for short circuiting the sections upon the ground return, thereby blowing the fuses between the sections.

Overhead Electric Railway, J. C. Henry, Westfield, N. J., 516,808. Filed Mch 8, 1893.

A diagonal system of overhead trolley construction.

Conduit for Electric Railways, H. A. F. Petersen, Milwaukee, Wis., 516,876. Filed Mch. 10, 1893.

Employs two parallel conduits, the one carrying the conductors being out of line with the slot and the longitudinal opening between the conduits being provided with a cover normally closed and only opened during the passage of the car. (See The Electrical Engineer, March 21, 1894.)

Telegraphs:—

Fire Telegraphy, S. J. Sanford, Barrie, Can., 516,879. Filed Feb. 3, 1891.

Telephones and Apparatus:—

Magneto Telephone, H. A. Chase, Boston, Mass., 516,642. Filed Aug. 12, 1893.

Employs a permanent magnet having one end free and provided at its opposite end with a rigidly attached pole piece by which it is supported upon the enclosing case.

Magneto Telephone, H. A. Chase, Boston, Mass., 516,643. Filed Aug. 12, 1893.

Employs a U-shaped exciting magnet located within the case and having legs of unequal length, and a magnetic connection attached to the rear end of the shorter leg and secured to the case to complete the magnetic circuit with the diaphragm.

Telephone Switch, A. Stromberg & A. Carlson, Chicago, Ill., 516,777. Filed Sept. 21, 1893.

Employs a horizontally shifting telephone hook yieldingly maintained at one end of its travel and a bracket so arranged that the placing of the receiver on the hook will force the latter in the opposite direction.

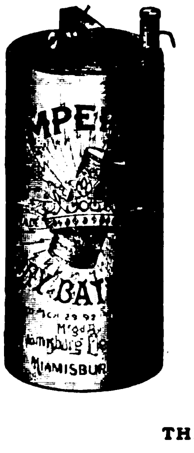
Telephone, A. C. White, Boston, Mass., 516,982. Filed Nov. 8, 1893.

Employs a diaphragm having one side cut off from communication with the outer air and a pressure equalizing or compensating device.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE IMPERIAL DRY BATTERY.



The accompanying illustration shows the Imperial dry battery, manufactured by the Miamisburg Electric Co., of Miamisburg, Ohio. It is constructed on novel principles and the possibility of internal short circuiting, or local action is claimed to be entirely eliminated. Its efficiency is high and the internal resistance is very small, owing to the compounding of the material surrounding the negative element, while its recuperative powers are excellent.

The battery is hermetically sealed, has a life of from one to three years and is not affected by climatic changes. It has a voltage of 1.5 and gives a current of from 6 to 8 amperes.

THE LARGEST HOLTZ MACHINE.

Messrs. Waite & Bartlett, of 143 E. Twenty-third street, this city, have recently completed what is said to be the largest Holtz induction machine ever made. It is contained in a case 7 feet 6 inches high, 6 feet 5 inches long and 3 feet deep. There are six revolving plates, each 45 inches in diameter and 5/16 inch thick and the stationary plates are 6 feet in length. The revolving plates are supported on a 2-inch steel shaft run by a ¼ h. p. Crocker-Wheeler motor. The pole pieces are 2 feet 9¼ inches long and a spark 21 inches in length can be obtained.

The machine was ordered by the Battle Creek Sanitarium, of Battle Creek, Mich., and a new form of transformer has been made to reduce its effect, when necessary, in order that it may be used upon the weakest patients.

NEW ENGLAND NOTES.

The Mather Electric Company of Manchester, Conn., report a large number of new contracts for work on hand. They are now operating their plant on full time and feel very much encouraged at the prospect of a larger business in the immediate future.

W. B. Southgate & Co. have opened an office at 146 Franklin street, Boston, and will act as general manufacturers' agents making a specialty of insulated wires. Mr. Southgate was for years with the Gould & Watson Co. and later with the Whitney Electrical Instrument Co., and has many friends in the electrical business.

Mr. C. I. Hills, well known to the electrical trade as a salesman of incandescent lamps, having been connected with the Perkins Electric Lamp Co. and the Waring Electric Lamp Co. for years, continues to meet with remarkable success in his new capacity as salesman for the Columbia Electric Co., of St. Louis. Mr. Hills's many friends in New England are all glad to hear of his success, and wish him the best of luck in his new venture.

The W. S. Hill Electric Co., of Boston, report that their switch exhibit, which attracted so much attention at the recent convention in Washington, is equally admired in the office of their agents, the Elson and Brewer Engineering Co., at 141 Liberty street, New York. Business with this company continues good, and they are running their shop to its full capacity ten hours a day.

The Campbell Electrical Supply Co. of Boston, are making a specialty of the "Century Insulating Tape," and are meeting with great success. The tape is specially woven, is extremely solid, firm and waterproof and will stand exposure to the atmosphere to a wonderful degree. It is put up in pound and half pound rolls, and in widths ¾ inch, 1 inch and 2 inches, so that it may suit all purposes.

Mr. F. LaRoche, of the LaRoche Electrical Works of Philadelphia, was in Boston this week, and paid visits to Westboro and Quincy, Mass., where there are several of his well-known type of alternating dynamos at work. Mr. LaRoche was much gratified to find that these machines had given so much satisfaction, and that there are good prospects for many more being used in New England, for which territory the Campell Electrical Supply Co. of Boston are agents.

The Pettingell-Andrews Co., of Boston, have increased their business so largely within the past year, that they are now forced to move into larger quarters, and after May 1st of this year will occupy a handsome store at 72 and 74 Federal street. They will take the whole first story and basement of this building and will have about twice as much space as heretofore. In these dull times it is quite refreshing to hear of a company doing so well that business demands larger premises, but we expect to see the Pettingell-Andrews Co. enjoying even a larger share of the patronage of the electrical trade than before.

Mr. J. F. Bubert, for several years in charge of the engineering and construction departments of Messrs. Claflin & Kimball, of Boston, has opened an office in the Hathaway Building, Boston, where he will continue the construction business in all its branches, having succeeded to that portion of Claflin & Kimball's business. Mr. Bubert has been connected with the Mather Electric Co. since 1884, and with Claflin & Kimball since 1889, and is well known to the electrical trade in the East as a proficient and care-taking electrical engineer.

Mr. J. Bradford Sargent, of Boston, New England agent for the Stirling water tube boiler, sends us the following very interesting test by Mr. George H. Barrus, the well known expert steam engineer of Boston, on a 250 h. p. Stirling boiler at Portland, Me.: Water evaporated per pound of coal, 10.54 pounds; equiv. evaporation per pound of coal from and at 212°, 11.025 pounds; equiv. evaporation per pound of combustible from and at 212°, 12.061 pounds; moisture in steam while boiler was developing 380 h. p. or 52% above its rated capacity, 0.19%; Moisture in steam while boiler was working at its rated capacity, 0.06%. A number of these boilers are now in successful operation in New England, and the above test will go far to prove in an emphatic manner the claims made for them, and will materially assist in the introduction of many more in this territory.

The Beacon Vacuum Pump and Electrical Co., of Boston, as their advertisement shows this week, are again leading the race in the incandescent lamp business with a reduced price list. They are now advertising their 16 c. p. lamps in barrel lots at 25 cents each, and expect to do a very large trade at this price. The Beacon lamp has recently met with much success, and they have been selling large quantities. In order to make more room for their increased trade, they have leased a floor in the building opposite their present premises, and will remove their machine shop to the new quarters. This will give them a much increased capacity for the manufacture of lamps, as they are at present somewhat crowded. The Beacon Company are evidently in the business to stay, and are determined to give their customers the very best price possible, and boldly advertise their price. It is only by their improved machinery and the fact that they intend doing a very large business that they are enabled to make this extremely low price.

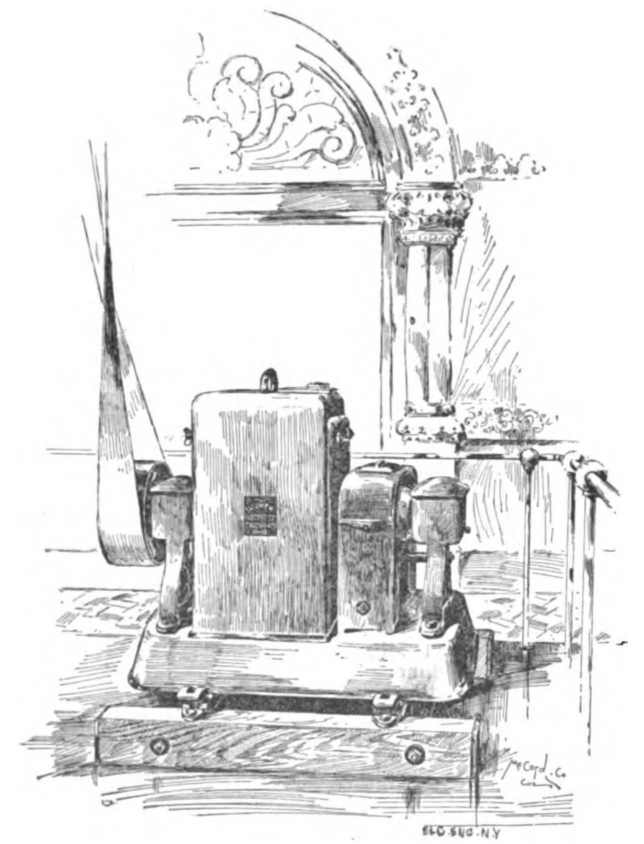
The Whitney Electrical Instrument Co. recently closed their office at 146 Franklin street, Boston, and are now transacting all their business from their factory at Penacook, N. H., which is in charge of Dr. Hoyt, the inventor of the instruments. On a recent visit to Penacook the writer found the factory to be peculiarly adapted for this class of work, being a large building entirely isolated from any other buildings, with large spacious rooms, particularly well lighted. The factory is run by water-power, and there is more than sufficient power to run the dynamos for testing and for charging storage batteries for the same purpose. The company has been recently re-organized and the following is a list of the officers; President, Hon. D. B. Varney; vice-president, F. T. Dunlap; secretary, O. B. Green; treasurer, David H. Young; electrician and general manager, A. H. Hoyt, M.D.; financial manager, E. R. Whitney; general selling agent, Henry F. Kellogg.

THE "TRIUMPH" IRON-CLAD DYNAMO.

RECOGNIZING a large demand for distinctively low-priced dynamos and motors that will do good work, the Triumph Electric Company, of Cincinnati, Ohio, has lately produced a machine of excellent design and workmanship, and capable of being sold at a very low price. The practical working of the machine has been exclusively considered and every point of mere beauty that would increase the cost has been omitted. That the result is far from unpleasing in appearance, however, may be seen by reference to the illustration showing the finished dynamo. The company's factory is equipped with modern machinery especially adapted to making these particular dynamos and motors, with the necessary accuracy to secure the best results. The designers and builders have had more than ten years' practical experience in the successful designing and building of electric lighting and power machinery and the knowledge so gained has enabled them to embody in the design of the Triumph machines many points of excellence found in others while avoiding certain common defects, in addition to several features of merit distinctively their own.

All Triumph dynamos and motors are provided with dust-, dirt-, and moisture-proof covered commutators, and carbon brushes brought in contact with the commutator end on, and requiring no filing or attention whatever and the brush holders are fixed and immovable. The spider is made to fit the shaft by casting it on. The shaft is first prepared by having three longitudinal grooves cut equidistant and somewhat shorter than the hub of the spider, into which the metal flows in casting, and shrinks, holding it firmly against lateral or endwise movement. The spider is of bronze. The armature-core is built up if thin discs of soft charcoal iron, toothed on their outer circumference to receive the wire. The conductors are thus embedded in the iron, and protected thereby, and are in such close proximity to the pole-pieces as to leave air space sufficient only for clearance in rotation.

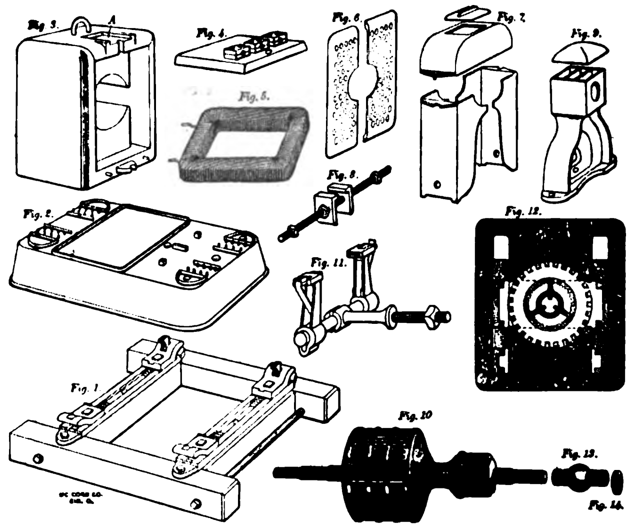
The discs used in these ammeters are slotted by a machine one at a time, so perfectly that when placed on the spider no filing or cutting is necessary to complete them. Mica insulation is used inside and out. The winding is simple, the connecting wires being brought straight out to the commutator without crossing or leads.



"TRIUMPH" IRON-CLAD DYNAMO.

The commutators are built of the best tempered copper, and are insulated with sheet mica. They are securely keyed to the shaft, and are of ample proportions.

In the group of construction details, Fig. 12 shows a cross section of the field core and coils, and their position in relation to the armature. It will be noticed that the iron of the core is in one piece, without break or joint, and that the coils are placed over the horns of the pole-pieces, and inclose the armature-core and coils directly. The armature being slotted with projecting teeth, brought in close proximity to the field-magnet, a minimuin amount of resistance is offered to the magnetic lines of force. The field coils are very simple in construction. They are wound on a rectangular form of cast iron, each layer being saturated with a special insulating compound. When the winding is completed, the coil and form is placed in a steam-heated oven, and kept there until the last particle of moisture is driven out. The coil is then removed from the form, and, after a first covering of heavy fuller-board, is carefully wound with three layers of covering tape, each layer covered with shellac, and again put in the oven and baked until thoroughly hard and dry.



DETAILS OF THE "TRIUMPH" DYNAMO.

Constructed in this way, and so placed on the poles that no part is in contact with the iron, a burn-out is claimed to be impossible.

PARAGON REFLECTORS.

The American Reflector and Lighting Co., of 80 Jackson street, Chicago, Ill., have issued a 32-page illustrated catalogue describing their "Paragon" reflectors for electric, gas and oil lighting. These reflectors are adapted to general uses, utilizing all the light and distributing it where it is wanted. They are made in a great variety of forms, depending upon the position in which they are to be used; also upon the area and shape of space to be lighted, the object being to have each reflector to give the best possible results, all things considered. They are well made on scientific principles and in a great variety of styles.

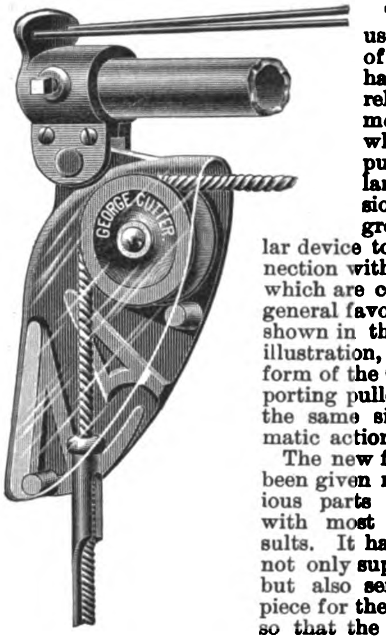
THE WHITE ADJUSTABLE LAMP HOLDER.

Messrs. O. C. White & Co., of Worcester, Mass., have issued a catalogue descriptive of their adjustable holders for incandescent lamps. The device consists of a combination of tubes and joints modeled after the principle of the human arm, with a ball and socket joint at the shoulder, a swivel joint at the elbow, and a wrist joint, which can bring the lamp into any position within its sweep. Each joint of the mechanism has an elastic pressure which is enough to hold a heavy lamp and shade firmly, and still will yield to a moderate force when it is desired to change its position. Both the upper and lower arm can be made longer or shorter at will, by simply sliding through the swivel joint. All the working parts are of metal, made interchangeable; insulating bushings protect the conducting cords, and ample provision is made for any possible wear by prolonged use.

THE NATIONAL ELECTRIC CO., Eau Claire, Wis., will move their Chicago offices to large and more convenient quarters on the thirteenth floor of the "Old Colony" building, on April 15th next. Messrs. Horne & Martin, their General Sales Agents, have just closed a contract with the Leland Hotel, Chicago, for the furnishing of two of the improved type National bi-polar incandescent dynamos.

MEMPHIS, MO.—A contract has been closed with the Franklin Electric Co., of Kansas City, Mo., for an incandescent electric lighting plant including new steam plant and Edison incandescent dynamo and construction.

CUTTER'S MAST-ARM PULLEY.



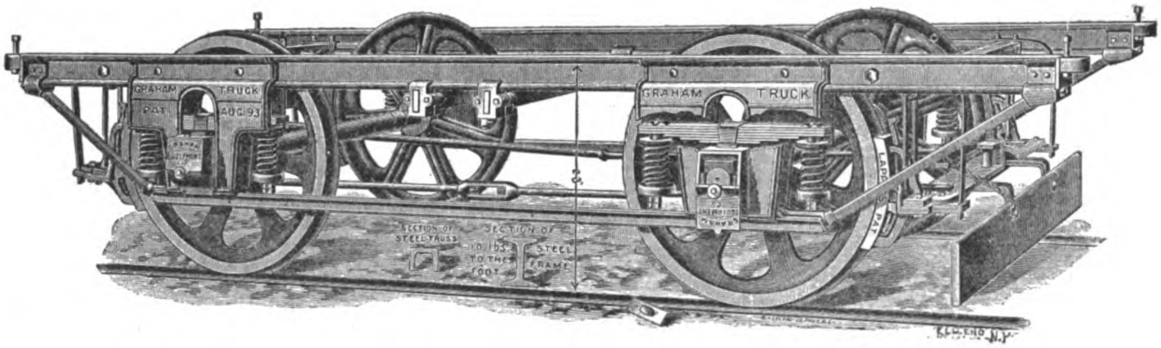
The extensive and continued use throughout the country of lamp supporting pulleys has shown that a simple and reliable safety pulley fills a most decided need. But while this form serves the purpose nicely wherever the lamps are hung from suspension wires, there has been a growing demand for a similar device to be used in connection with the mast-arms which are coming into more general favor. The result is shown in the accompanying illustration, being a modified form of the Cutter lamp-supporting pulley and retaining the same simple and automatic action.

The new form has already been given rigid tests in various parts of the country, with most satisfactory results. It has a clamp which not only supports the pulley but also serves as a head-piece for the end of the arm, so that the bracing can be done from this point. All parts are well made and japanned, the supporting hook-knob being of malleable iron. This new pulley seems to be a practical device and the maker, George Cutter, of Chicago, expects a large sale.

THE GRAHAM "ELECTRIC" TRUCK.

The accompanying illustration shows a street railway truck especially adapted to electric roads, manufactured by the Graham Equipment Company, of 258 Washington street, Boston and 741 Drexel building, Philadelphia. Its design, as will be seen, is very simple. It has a strong brake gear with few parts, and will, it is claimed, carry the car body without oscillation of any kind, as the reciprocal arrangements of straight leaf springs cushioned on spirals neutralizes the "teetering" motion.

It has but sixteen bolts, and no rivets, hot or cold, to rust or rattle loose. Its pedestal jaws fit down over the axle box and prevent the car from surging forward on the springs when the brakes are applied. The truss rods extend continuously from one end of the I beam to the other, and are bolted to the pedestals, making a perfect truss. It is claimed that this is the only electric truck with truss rods that are a direct support to the truck frame and car body.



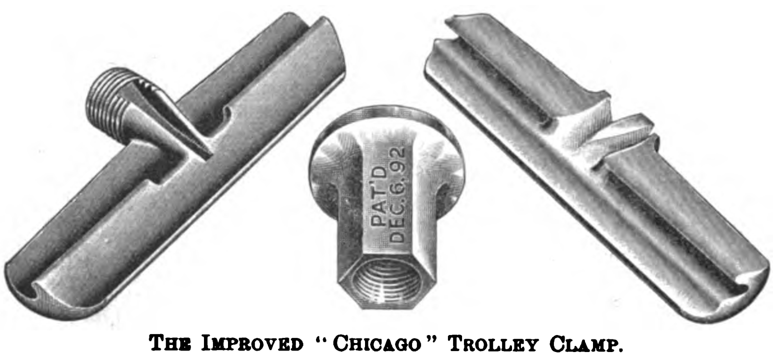
The Graham "Electric" Truck.

This form of truck has had hard service on various street railway throughout the country, and, judging from the reports of the users, seems to have given the utmost satisfaction.

Queen & Co., Philadelphia, are having a large demand for their Acme Portable Testing Set, which is, they consider, the most compact thing of its kind on the market, and for the rapid measurement of resistances the non-pareil. The demand for "Magnetic Vane" ammeters and voltmeters would seem to indicate a very pronounced revival of business among the dynamo and motor manufacturers.

THE IMPROVED "CHICAGO" TROLLEY CLAMP.

The accompanying illustration shows an improved form of the "Chicago" trolley clamp, now being introduced by the inventors, Messrs. J. S. Gustin & Co., Chicago. While the clamp itself has been in use, especially on some of the Chicago trolley roads, for some time, giving excellent satisfaction, the inventors have lately made several desirable changes in the design, one of which consists in so modifying the shape and dimensions of the tongues, as to expose the under surface of the trolley wire to contact with the wheel throughout the entire length of the clamp, thus avoiding the injurious arcing of the trolley wheel when passing hangers. Another improvement consists in doing away with the off-set in the clamping nut. This not only adds to the symmetrical appearance of the clamp, but also avoids the striking of the nut by the wheel flanges, in case the wheel should not run true. Finally, the tongues on the inner surfaces of the clamp have been given a slightly greater angle, which increases the gripping power of the clamp to a considerable extent.



The Improved "Chicago" Trolley Clamp.

ELECTRIC APPLIANCE CO.

The Electric Appliance Co., Chicago, are beginning the usual spring campaign with the "Swinging Ball" lightning arrester and are meeting with their usual success. In fact the Swinging Ball Lightning Arrester has held the field for so many years that it does not now require any very aggressive work to call forth a large demand for this desirable specialty. As is well known the Swinging Ball Lightning Arrester is particularly well adapted for a line arrester and is almost exclusively used in this way. The manufacturers promise something new this season in a station arrester built upon an equally effective principle.

The Electric Appliance Company's new specialty the "Allen Soldering Stick" is meeting with the general approval of the trade and is already in large demand. Its convenience, and the ease with which it can be manipulated, are strong points in its favor. In addition to this it is cheaper than acids and soldering salts, and with its use work can be very much facilitated. The time saved in making joints is quite a valuable item.

A GOOD CONTRACT FOR THE HUBLEY MFG. CO.

The Citizens' Light, Heat and Power Company, of Lancaster, Pa., has awarded the Hubley Manufacturing Company, of that city the contract for furnishing about seventy miles of copper insulated wire to be used in the construction of their new lines.

AN EASTER OFFERING.

Glass pens have heretofore been considered something of a luxury even by the most affluent of our citizens; but by the action of the Law Battery Co., 85 John street, New York, these are now placed within the reach of all who can afford a few pennies for postage, provided they quickly make known their wishes. The pen which this company so freely offers will prove a boon to many who have suffered in times past because of the weariness of writing, while the young idea of the household may take its first lessons in the art, even if only by tracing the letters which form a striking advertisement in the interior of the holder.

NEW YORK NOTES.

Mr. G. H. Almon, formerly of 136 Liberty street, selling agent for the Belknap Motor Co., has sold to the Bishop Gutta Percha Company of this city two 11 k. w. dynamos and a 10 h. p. motor.

Mr. Louis O. Brewster, 136 Liberty street, has become New York manager of the selling agency of the Belknap Motor Co. and the L. P. & D. Transmitter Co. He is associated with Mr. G. H. Almon, who has assumed charge of the Boston office.

The Metropolitan Traction Co. will, it is said, soon adopt a conduit system for one of its roads in New York City, and the Twenty-Third Street is mentioned. It is also stated that the Siemens-Halske system as used at Buda-Pest may be given a trial.

The American Mfg. & Eng. Co., jobbers and manufacturers, consulting and electrical experts, have opened offices at 143 Liberty street (the Central Building), where they will be glad to hear from the profession and trade. Mr. W. M. Miner is the electrician and general manager.

The Bishop Gutta Percha Co., 420–6 East Twenty-fifth street, has issued a very neat and handy little pamphlet of "Tables, Rules and Information" for architects and electrical engineers. It includes the rules of the New York Board of Fire Underwriters, and rules for wiring on the basis of 55 watt 16 c. p. lamps, etc.

The General Electric Company have perfected their woven wire dynamo brushes for all of the machines they manufacture with the exception, of course, of the arc dynamo. The brushes are made of fine wire gauze, which is first wound into rolls, and then shaped into brush form under heavy pressure. It is said that they are smooth, give excellent contact, run cool and do not fray.

The Direct U. S. Cable Co. (Ltd.) circulates a neat little slip in which it quotes the following from one of the New York dailies:—"The Direct Cable Company achieved another victory over its competitors yesterday in transmitting to the United Press its announcement of the result of the Oxford-Cambridge boat race on the Thames. Ten seconds after the dispatch was filed in London it was signaled to the United Press office in this city, thus anticipating the announcement by other lines from three to ten minutes."

WESTERN NOTES.

The iron roof over the dye house for Geo. C. Hetzel & Co., at Chester, Pa., will be furnished by The East Berlin Iron Bridge Co., of East Berlin, Conn.

The Metropolitan Electric Company are getting in a stock of porcelain floor tubing of all sizes, to meet the requirements of the Board of Underwriters.

The Manhattan Electrical Supply Co. have found it necessary to remove to more commodious quarters, and are now on the ground floor of 32 Cortlandt street, New York City.

Mr. Jno. L. Martin, of Horne & Martin, Chicago, who suffered the loss of his left arm on March 22nd, is reported as doing nicely, and it is hoped that he will soon be able to attend to business.

The Home Telephone Company, Bloomington, Ill., has been incorporated, the capital stock being $30,000. The incorporators are Jas. B. Taylor, Owen Scott, A. B. Hoblet, F. M. Funk, H. C. Demotte and B. M. Kuhn.

The Metropolitan Electric Company note that the dynamo and motor makers are using P. & B. armature varnish with satisfactory results; the larger companies buying in barrel lots. The company carry a full stock of the P. & B. specialties.

The Buckeye Electric Co., 401–404 Cuyahoga Building, Cleveland, O., has just issued two neat little circulars, one referring to its electric railway incandescent lamps which are anchored at the side; and the other to its special coiled filament lamp for decorative, steamship and kindred lighting where a short lamp is needed. This special lamp is but 4¼ inches long, while the standard average type is 5¼ inches.

The Strowger Automatic Telephone Exchange of Chicago has ordered one hundred No. 1 Standard magneto telephones from the Western Telephone Construction Co., of Chicago, to replace the battery telephones of the Exchange at La Porte, Ind.

Lincoln & Co., Chicago, have opened offices at 934–935 Monadnock Block, and will act as manufacturers' agents for high-class electrical goods. They have secured the agency for several important specialties and Mr. Lincoln's extensive acquaintance among the trade, coupled with low prices for first-class goods, should secure them a liberal share of the business.

The Central Electric Company are in receipt of the following communication from one of the leading electric light companies in the country: "We are obliged to you for your calendar for 1894. We were on the point of writing for one, because it was the most sensible and complete one we had last year, and we hoped you were printing one of the same style for this year." The Central calendar is certainly a complete electrical calendar, and any one in the trade who has not received one, should request the Central Electric Company to forward one at once.

Fisher & Porter, 1025 Monadnock Block, Chicago, report that they see evidence of a good business in the immediate future. They are equipping with machinery, for W. H. Roessle, of Pittsburgh, a gold mine at Tellico Plains, Tenn., and have supplied Kotine, a new material for painting iron structures, for the new Lincoln Park bridge, recently erected by the Pittsburgh Bridge Co. They have the contract to supply two 75 h. p. M. A. Green engines for the Leland Hotel in Chicago, and have several contracts of a similar nature ready to be closed.

The Electric Appliance Company are just placing upon the market something which is entirely and absolutely new. This means that it is not an improved form of something else that has been on the market but is in itself an entirely new production; something that has never been used and probably never thought of before. It is the Allen soldering stick; a soldering flux in solid stick form to take the place of resin, acids and soldering salts. It is put up in candles one inch in diameter and six inches long and is applied by simply rubbing on the joint when heated. It is a wonderful time-saver and is said to be actually cheaper in first cost than soldering salts or acids, and not in any way to corrode the joint or affect the insulation. The Appliance Company are furnishing small sample sticks free on application.

MONTREAL NOTES.

Mr. J. E. Wilson, of the Pettingell-Andrews Co., of Boston, who was a recent visitor to Montreal, reported business good and the outlook bright.

Mr. H. F. Kellogg, general selling agent of the Whitney Electrical Instrument Co., was in the city last week. Mr. Kellogg finds a growing sale in Canada for the Whitney instruments which are giving universal satisfaction.

Mr. John Forman, of Montreal, has entered into business as importer and dealer in electrical supplies and has taken a commodious store at 650 Craig street in that city. Mr. Forman is well known to the Canadian trade and starts business under favorable auspices, having secured the Canadian agencies for Messrs. Crompton & Co., the Edison and Swan United Co. and several other well known English concerns. United States manufacturers who desire to introduce their goods in Canada are invited to correspond with him.

The Bell Telephone Co., of Canada, have commenced suit against the Montreal Street Railway Co. to recover over $27,000 damages, the cost of putting common return wires on their telephone system in Montreal, up to the date of entering the action. The Bell Telephone Co. state that the introduction of the trolley system of electric traction by the Montreal Street Railway Co., has necessitated the installation of the return wires and the abandonment by them of the use of the ground as a return. They claim that, having rightfully enjoyed the use of the ground for this purpose from the time of the establishment of their telephone system in Montreal, the Street Railway Co. should therefore reimburse them for the expense of making the change. Heretofore, the suits brought by telephone companies against electric railway companies have been for injunctions to prevent the introduction of the single trolley system, and this is believed to be the first time—at least in Canada—that recourse has been had to an action for compensation for the cost of altering the telephone system to overcome the interference of the trolley system.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.
Vol. XVII. APRIL 11, 1894. No. 310.

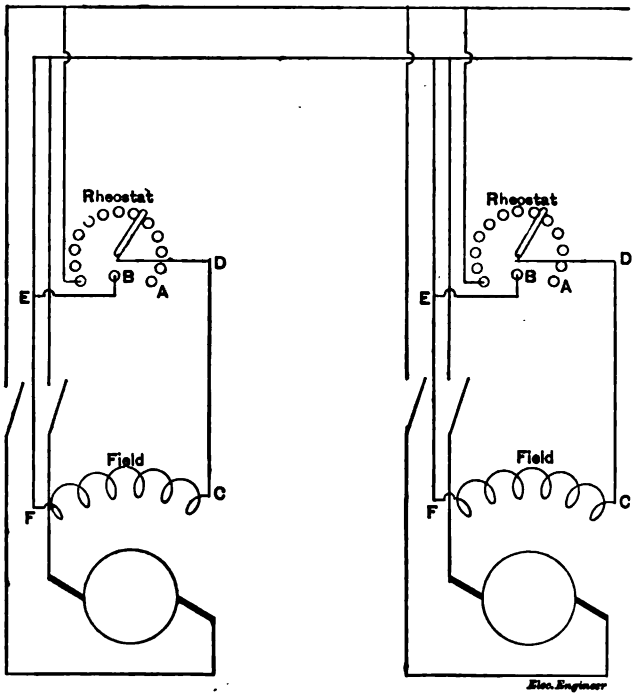
DISCHARGE OF FIELD MAGNETS WHEN CONNECTED TO BUS BARS.

BY

Wm. A. Anthony.

I FIND in Mr. Herrick's paper on "Central Station Switch Boards," which was read at the Washington meeting of the National Electric Light Association, the following passage referring to the method of handling dynamos where the fields are excited from the bus bars:

> **The disadvantage of this method is, that the field is on, although the dynamo may be shut down, and it is necessary to discharge it through a bank of lamps or other resistance by means of a field break switch. This method of discharge, although safe, might cause trouble should the bank of lamps be disconnected or otherwise out of order.**



Method of Overcoming Field Magnet Discharge.

This passage calls to mind discussions that I have many times had with electricians as to the necessity of discharging the field *through a resistance.* Why not short circuit it? The impression seems to be quite general that a resistance approximately equal to that of the field should be provided, and the switch which breaks the field circuit arranged to discharge the field through this resistance. I have never been able to obtain a clear statement of the reason for this belief. The Mather Electric Company has for several years constructed the field rheostats for large machines, and especially for 500 volt generators, to admit of the connections shown in the sketch. As the rheostat lever is turned toward the right, resistance is introduced into the field circuit, gradually reducing the current until, when the lever passes off the point A, the circuit is broken. But at the instant of passing off the point A, contact is made with the point B, which short circuits the field and permits of its discharge through a circuit C D E F, of practically no resistance.

I have been informed that the electrical engineer in charge of the erection of one of the Mather plants insisted that their agent who was having the plant installed, should have a resistance inserted in the branch B E. The paragraph quoted at the beginning of this letter recalled this matter to my attention and leads me to state the theory of the action as I understand it.

When the field circuit is broken, the dying out of the magnetism develops an E. M. F. in the field windings tending to produce a current in the same direction as that which magnetized the field. If no path is offered through which this current can flow, this E. M. F. develops a difference of potential between the field terminals and between different parts of the field winding, that may amount to hundreds or thousands of volts, sufficient to break down the insulation and cause serious damage to the field coils. If, however, a path of no resistance, as C D E F, is provided between the field terminals, the E. M. F. will be almost wholly employed in producing current through that circuit, and no appreciable potential difference will be developed The current through the short circuited field can never be greater than that which originally excited the field, because it is produced by the *falling* magnetism, is in the same direction as the exciting current, and, if it should equal it, the magnetism could not fall. Further, the potential difference between F and C can only be such as would maintain his current through the resistance C D E F, and the smaller this resistance, the less this potential difference. Further still, the less the resistance in C D E F, the greater the current developed by the falling magnetism; the greater the current the more slowly does the magnetism fall, and the more slowly the magnetism falls the less is the E. M. F. There is every reason then for making the resistance of C D E F as small as possible.

This arrangement of the rheostat saves the necessity of an extra field switch, and insures the partial cutting down of the exciting current before it is finally broken.

GROUNDS ON INCANDESCENT CIRCUITS.

BY

Geo. L. Thayer.

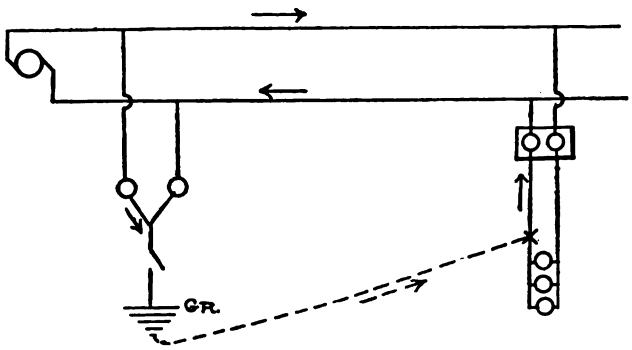
Locating grounds on electric lighting plants or installations is one of the duties which the average station manager always regards as extra work, principally because they seem to come at the most inopportune moments. Then it is so easy "to let it go" until a more convenient time comes to hunt it up.

Grounds are naturally divided into two classes, outside and inside grounds. Where the line is in a conduit, the location of trouble requires special methods, depending upon the construction. On pole work grounds can usually be easier located by actual inspection of the line than by testing. The great majority of grounds are inside, and are caused by contact with the iron pipes in the building. They are concealed, and electrical methods must be used for their detection and location. The larger wires, carrying heavy currents, are generally run in places where they are not apt to be disturbed and their extra thickness of insulation is more or less a protection against mechanical injury. The result is, that most of the grounds occur in fixtures or in drop cord sockets resting against gas fixtures or steam pipes.

In practice it is usually better not to test large sections of the installation at one time when the current is on, because of the burning of connections when circuits carrying, say, ten amperes or more are opened. The wires too are heavy and frequent bending is liable to break them.

Testing with a magneto, or with a galvanometer and battery generally necessitates a search for something on which to ground one side of the testing apparatus and running a wire to it, all of which takes time. On alternating current circuits this is of course the best method, as there is no electrical connection between the primary and secondary circuits. But in direct current plants the ground detector may be used as the necessary ground. When current is on, the only apparatus needed is a socket wired with a few feet of wire or cord and a 16 c. p. lamp. When current is off, a magneto must be used instead.

Referring to the accompanying diagram, let the cross denote a ground on the negative side of the system. When the ground detector switch is closed, current flows from the dynamo through the ground detector lamp to ground, entering the system through a ground at some unknown point. Now if a lamp be placed anywhere in this circuit, say at the cutout, it will light up and indicate the faulty circuit.



Locating a Ground.

If the circuit is broken at the cutout and the lamp cut in, the lighting up of the lamp to low incandescence will locate the ground on that particular branch. Taking one cutout at a time, both sides are opened and the lamp placed in the negative side of the cutout, assuming of course that the ground has been shown to exist on the negative side of the circuit. The lamp will show at once whether that branch is clear or not. If no lamps are burning on that circuit, the positive wire need not be opened. Each circuit is tested in a like manner until the trouble is located in some one of them when it can be further located by the usual methods. Of course the absence of results shows that it is somewhere on the mains and feeders.

Testing may be begun by testing the main cutouts. The arcs formed when the heavier currents are broken burn the binding posts. The wires are No. 12 and larger and frequent bending is apt to break them off; besides, the trouble will usually be found in the end on the smaller branch circuits. In central station work the building should of course be located first. Where plug cutouts of the Edison type are used, the testing lamp may be screwed directly into the cutout. In city plants there are always a few lamps burning and it is very desirable to interrupt the service as little as possible. One man can cover as much ground with a lamp as two can with a magneto. If the ground is of very high resistance, a cheap galvanometer should be used instead of the lamp. The time at each test is small, but for an entire plant, it amounts to a surprising difference.

It may be urged that grounding the system in this way in order to test it, is bad practice on account of fire from the heat generated at the point of trouble; this is true, but the danger is more apparent than real. A dead ground, or one of above 1,000 ohms resistance would not be apt to give any trouble by fire. How many plants run along with grounds on both sides of the system? It would take time to develop a fire from this cause, and the testing of the largest isolated plant need not exceed two hours. At the end of the test the men would have located the ground and an incipient fire would run an exceedingly small chance of getting a good start. In any case the chance of danger can be avoided by making the artificial ground of high resistance and using a galvanometer, which, after all, is the better way. Right in here comes the subject of blowing out grounds. *Don't;* at least, don't make a practice of it. It is at best a heroic remedy. In any event the general location of the ground should be ascertained first and a careful watch kept for fire for some hours afterwards.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—IX.

BY

Mary A. Henry

Henry's paper was in print.[1] In the wide circulation of Silliman's Journal it was carried abroad to place Henry at once among the scientific men of Europe. "At one bound" says Prof. Lovering "he came to the front. He had introduced his magnetic children into the world; had sent them forth to do their important work and how were they received? With surprise, nay with astonishment."

Mr. William B. Taylor says, "The magnetic 'spool' of fine wire, of a length tens and even hundreds of times that ever before employed for this purpose, was in itself a gift to science which really forms an epoch in the history of electro-magnetism. It is not too much to say that almost every advancement which has been made in this fruitful branch of physics since the time of Sturgeon's happy improvement, from the earliest researches of Faraday downward, has been directly indebted to Henry's magnet. By means of Henry's 'spool' the magnet almost at a bound was developed from a feeble childhood to a vigorous manhood. And so rapidly and generally was the new form introduced abroad among experimenters, few of whom had ever seen the paper of Henry, that probably very few indeed have been aware to whom they were really indebted for this familiar and powerful instrumentality.[2]"

"But in addition to this large gift to science Henry (as we have seen) has the pre-eminent claim to popular gratitude of having first practically worked out the differing functions of two entirely different kinds of electro-magnet; the one surrounded with numerous coils of no great length, designated by him the *quantity* magnet, the other surrounded with a continuous coil of very great length, designated by him the *intensity* magnet.

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[1] It was printed Jan. 1st. 1831.

[2] Henry's spool magnet appears to have been introduced into France by Pouillet in 1832. *Nouveau Bulletin de Science:* Publié par la Societé Philomatique de Paris, of 23 June 1832 p. 127. In Pouillets Éléments de Physique. 3rd Edition Vol. 1, p. 572 the date of this magnet is given as 1831—In the second Edition, 1832, no allusion to the magnet occurs.

"Here for the first time is experimentally established the important principle that there must be a proportion between the aggregate internal resistance of the battery and the whole external resistance of the conjunctive wire or conducting circuit.

"Never should it be forgotten that he who first exalted the *quantity* magnet of Sturgeon, from a power of twenty pounds to a power of twenty hundred pounds, *was the absolute creator of the intensity magnet*, and that the principles involved in this creation, constitute the indispensable basis of every form of the electro-magnetic telegraph since invented."

Faraday, working away at an experiment that had failed him again and again, immediately adopted the new method of obtaining magnetic force, to make, in this same year, 1831, that discovery of magneto electricity I have noticed in the last chapter, and by its means also his subsequent discoveries of dia-magnetism and the magnetic effects on polarized light were made.[3]

A very pleasant welcome to the magnets was the generous tribute to them of Sturgeon. He says, "Henry has been enabled to produce a magnetic force which totally eclipses any other in the whole annals of magnetism, and no parallel is to be found since the miraculous suspension of the celebrated oriental imposter in his iron coffin.[4]

At home Dr. Hare, of Philadelphia, received with enthusiasm the new means of producing magnetic force. He says in a letter to Sturgeon, the following year April 5, 1832: "As soon as I heard of the wonderful magnets of Prof. Henry, I repeated his magnetic experiments, and I have recently made a magnet by means of copper wire shell-lac varnish and paper, surrounding the iron, which in proportion to its weight holds more than his." Prof. Silliman evinced his appreciation of the magnets by ordering the powerful one which continued to be an object of veneration and pride at the University of New Haven until last year, when it was sent to the National Museum for exhibition.

This magnet was nearly twelve inches high and was made to lift 2,035–2,063 lbs. A number of very interesting experiments were made with it before it was sent to New Haven. "To test its power of producing magnetism in soft iron, two pieces of iron ¼ of an inch in diameter and 12 inches long, were interposed between the extremities of the magnet and the armature, and these when the battery was immersed became so powerfully magnetic as to support 155 lbs. To exhibit the effects produced by instantaneously reversing the poles—the armature was loaded with 56 lbs. which added to its own weight made 89 lbs. One of the batteries was then dropped, when the weight of course continued to adhere to the magnet. The other battery was then suddenly immersed when the poles were changed so instantaneously that the weight did not fall. That the poles were actually reversed in the experiment was clearly shown by a change in the position of a large needle placed at a small distance from the side of one extremity of the horse-shoe."[5]

In his letter accompanying the account of the magnet in his journal Prof. Silliman says :—

"The magnet is now arranged in its frame, in the laboratory of Yale College. There has not been time, since the magnet came just as this number was finishing, to do anything more than make a few trials which have, however, fully substantiated the statements of Prof. Henry. He has the honor of constructing by far the most powerful magnets that have ever been known. And his last, weighing, armature and all, only 82½ lbs. sustains over a ton. It is eight times more powerful than any magnet hitherto known in Europe and between six and seven times more powerful than the great magnet in Philadelphia."[6] July 21, he writes—"Your magnet performs admirably well and excites great interest among the students. A favorite mode of exhibiting the magnet is to allow a number of young men to stand upon the scale, as the weight lifted then appears more striking. This never fails to excite the astonishment of the spectators."

The venerable president of Yale thus speaks of the magnet :—

"There was nothing to be said when, as the plunger went down into its bath, the impotent bar of iron became possessed of a giant's strength and could pick up and hold a weight of more than a solid ton, and as the same plunger was lifted this gigantic energy vanished as at the word of an enchanter. The speaker well remembers the excitement which this discovery occasioned when the first experiment was tried at Yale College, in the presence of a few spectators who casually met at the call of Prof. Silliman, who was glowing with animation and delight. The ponderous platform was loaded with pig-iron and other heavy weights, with a few slight additions of living freight. Among the last was the speaker, being the lightest of all, and therefore convenient to serve on the sliding scale. It is more than fifty years ago but the scene is as vivid as the events of yesterday. The question went around who is Professor Henry, and how did it happen that nature revealed to him one of her choicest secrets. Thoughtful men asked what is this wonderful protean force which he was the first to follow in its sinuous hiding places and evoke by a magician's wand ; and what are its relations to its kindred agents, and, above all, to the matter about us which we can measure and weigh and see and handle. To some it seemed but a successful guess by a daring adventurer. A lucky accident like the drawing of a prize in a lottery. It was not so with those who retraced the successive steps of close observation, of sagacious interpretation, of boundless invention, of ingenious construction, of patient trial, of loving sympathy which preceded this single achievment and all of which combined lifted at once this youth, hitherto unknown, into the rank of the most eminent discoverers, brilliant as was their company, then and since."

Innumerable applications for magnets now poured in upon Henry, and for other magnetical apparatus. A powerful magnet equal to the one sent to New Haven was ordered by Prof. Cleveland for Bowdoin College, Brunswick, Maine.

The making of the magnets consumed much time and labor but Henry in every case refused remuneration for his personal labor, charging only the actual cost of materials and hired work. "I consider it," he says, "below the dignity of science to take pay for my knowledge." (Letter Nov. 4, 1831.)

Not only these new galvanic magnets occupy Henry's attention: we find him engaged in preparing a large steel permanent magnet for use in the separation of iron from ore. This inspires him with the desire to bring his own electro-magnets into the work. In a letter sending this to Mr. Rogers, Nov. 4, 1831, for whom it was constructed, he says, "I am confident I can form a galvanic machine which will effect powerfully the separation of iron, and upon this effort he spends much time and thought.

A detailed description by Professor Henry of his mode of constructing an electro-magnet may be interesting. I give part of a draft or copy of a letter to Professor Cleveland :—

ALBANY, May 8, 1832.

After a delay, which I fear has nearly exhausted your patience, I have at length sent off your magnet according to the direction given in your letter of the 8th of Dec. I can get nothing done in Albany in the philosophical line except I stand over the workman continually myself, or which is most often the case, do the work entirely myself. * * * *

The following is a particular description of the construction of the magnet. * * * *

The horse-shoe is formed of a bar of American iron, which according to the mechanic's account was unusually hard. It was not selected on this account, but was taken because it was the only piece of iron of the proper size to be procured at that time in Albany. After bending it into the proper form, the edges were first rounded with the hammer and afterwards with a file, and in order to prevent the wires, to be coiled around it, from slipping off the legs, a deep groove was filed into each, about half an inch from the end.

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[3] See Faraday's Researches.

[4] *Phil. Magazine*, March, 1832.

[5] Henry's paper in *Silliman's Journal*, for April, 1831.

[6] Prof. Silliman is here alluding to permanent magnets.

The horse-shoe, when it came from the hands of the finisher, weighed 60 lbs.—the armature about 20 lbs., and these are almost precisely the weights of the magnet and armature of Yale College. The winding on of the wires was done with great care, and under my constant inspection, according to a method which I think much preferable to any I have before adopted. Instead of covering the wires with cotton or silk-thread, I gave them several coats of varnish made of shell-lac and mastic, and in order to render the insulation of the several wires still more perfect a thickness of silk was woven as it were, between every *spire* or turn of each wire, and the several layers of wires were separated from each other by a covering of silk and varnish.

The operation was as follows: The iron horse-shoe was, in the first place, covered with a coating of varnish, and while this was yet soft, the whole was wound with strips or ribbons of silk. A coating of varnish was then given to the silk and suffered to dry before the winding of the wire was commenced.

In coiling on the wire, one *spire* was passed around the horse-shoe, with the end of a long and broad flap of silk between it and the iron: the flap was then turned back so that the second *spire* should pass under the silk—the third spire passed over the silk—and the fourth again under it—and so on in this way until the whole surface of the horse-shoe was covered with one thickness of wire. A coating of varnish was then given to this surface of wires, and the whole covered with ribbons of silk. Another coating of varnish was given to the silk, and after this became hard a second layer of wires was coiled on in the same manner as the first.

This process was a very tedious one, and occupied myself and two other persons every evening for two weeks. It is, however, one which insures success if the iron and other circumstances are favorable. The iron is entirely covered with four thicknesses of wire, and near the ends with five. There are in all 30 strands, each 35 feet long, so that exclusive of the projecting ends there are about 1,000 feet of wire actually coiled around the magnet. It is necessary to be very cautious that in the arrangement of the several wires there are none which will conduct the galvanic current in an adverse direction, or that will suffer it to pass from one wire to the other without circulating throught the entire length around the magnet. I have failed in this respect in some instances to produce any effect when I expected a very great one. * * * *

To exhibit the experiment of the instantaneous change of polarity, a second battery must be attached by means of the thimbles of mercury, in such a manner that the galvanic current from this battery will circulate in an opposite direction to that from the battery attached permanently to the magnet. Load the armature with two or three hundred pounds and excite the magnet by the second battery; let an assistant be ready to raise the vessel from immersing the first battery. Let this be done suddenly, and at the same time quickly withdraw the wires or poles of the second battery from the two thimbles—the weight will still continue to adhere. To render the fact evident of the change of polarity, I place two magnetic needles one on each side of the magnet, and these, by reversing their position relative to the magnet will indicate in a very striking manner the change of polarity. I find it most convenient to make these needles each of two pieces of watch-spring, about ten inches long, touched separately, and then with their north poles joined together by a silk thread with a little brass cap between them. A small piece of light cord is placed on each end with the letter N on one and S on the other.

In the box containing the battery you will find two pieces of round iron; these are for showing induction of magnetism in soft iron. They must be placed upright on the face of the armature, at such a distance from each other that their axes will be in the centre of the faces of the horseshoe. While in this position immerse the battery and the two iron cylinders will adhere to the magnet and the armature to them, as firmly almost as if they all were but one piece.

N. E. L. A. STANDARD RULES.

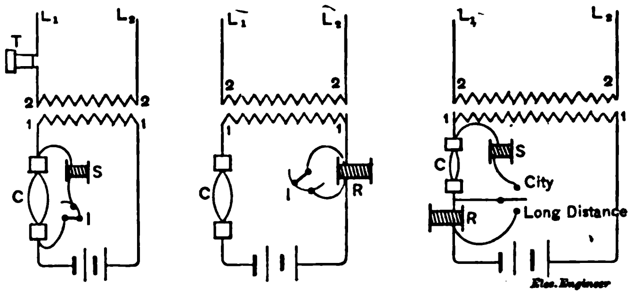
We have received copies of the new N. E. L. A. Standard rules for lighting, wiring, &c., put up in a very neat pocket size, 32 pages, 9 by 5¾ in. They are supplemented by the report on arc lamp rating and by a glossary of electrical terms. There are also a preface and an index. These rules represent a great deal of work and are a great credit not only to the Association but to the successive committees, Mr. W. J. Hammer being the active and efficient chairman of the one reporting to the Washington convention. Work of this kind still remains to be done, and it is but to be hoped that the Association will continue to enjoy such devoted and intelligent assistance.

THE MERCADIER AND ANIZAN MICROPHONE REDUCER.

Taking the condition of telephony as we find it to-day in different countries, and considering the progressive development of long distance lines, transmitters ought to be so arranged that one subscriber shall be able to talk as well with another in the same city as with one a hundred or two hundred miles off. Necessarily it is the microphone which ought to be studied in order to obtain as good talking for short as for long distance.

With microphones embodying carbon pencils it is necessary that the microphone contacts be very sensitive and very light when used for long distance work. One would then be quite limited by the noise caused by the too sensitive microphone in the telephone of the person talking; but this can be counteracted by means of a differential winding. To communicate over a short distance in a city district with copper wires it would be necessary, on the contrary, to have the microphonic contacts not very sensitive. In granulated carbon microphones one could vary at the same time the surface contact of the carbon electrodes and their distance, according to whether one desired to use the microphone for long or short distance.

Finally, whatever be the type of microphone, whether carbon rod or granules, one can also for a given regulation of the microphone contacts make the same microphone serve for long distances by taking a thin diaphragm of large diameter; and for short distances by mounting the microphone on a thick diaphragm of very small diameter. One can get an analogous result by taking diaphragms of the same dimensions, but of different materials, such as iron and wood. In the United States the American Bell Telephone Company use two types of microphone transmitters, one for city and one for long distance work. In Europe there are still employed microphones regulated in such a way that they can serve either for short or long distance, but, as indicated above, these microphones do not give all that could be got out of them for long distance work, in order not to impair too much their clearness for short distances, and vice versa. It will thus be seen that the two desirable qualities in the regulation of the microphone, loudness and clearness, are opposed to each other, and that one can be obtained only at the expense of the other.



FIGS. 1, 2 AND 3.

The microphone reducer of MM. Mercadier and Anizan has for its object, first, to give to a microphone its maximum intensity when used for long distances, and, second, to obtain from the same microphone a proper loudness and clearness when it is used for short distances. The diagram, Fig. 1, represents diagrammatically the arrangement which consists simply in placing for a given time a resistance in shunt to the carbons. This shunt S has about three ohms resistance. I is an ordinary switch for opening and closing the shunt circuit. The whole can be placed inside the transmitter boxes with a small handle projecting through the lid, which operates the switch I. When the index on the handle points to "City" the switch is closed, and when pointing to "Long Distance" the switch is open.

Two terminals on the outside connect the reducer with the carbons of the microphone.

It has been possible to sensitize the microphone so as to make it as powerful as desired. If differential telephones are not used one would nevertheless be limited up to the point where the sputtering sound would become annoying to the talking subscriber. A single experiment on an artificial line having resistance and capacity allows the maker of the microphone to find the proper point of regulation. The diminution in loudness of the microphone so arranged is explained by the fact that, a part of the current passing through the shunt, the variations of resistance of the carbons only act on the part of the current which passes through the carbons. The clearness is good because whatever be the sensitiveness or mobility of the carbons the maximum resistance of the vibrating carbons in combination with the shunt can never exceed the resistance of the shunt. If we call C the resistance of the carbons and S that of the shunt, the total resistance will be $R = \frac{C\,S}{C + S}$. Naturally, C varies at each instant when talking before the diaphragm of the microphone. We may conclude from what precedes that there ought to be a benefit by placing a fixed shunt around the carbons of microphones which are too sensitive and subject to sputtering.

It is important to determine by experiment the value of the resistance of the shunt. It has been observed, in fact, that if a resistance of 10 ohms be placed in shunt around the carbons which have themselves a resistance of 10 ohms when at rest, the strength of the telephonic currents is scarcely diminished. If, on the one hand, half the current passes through the shunt we must not lose sight of the fact that, on the other hand, the combined resistance of the carbons and the shunt is only five ohms. The strength of the current which passes through the primary circuit of the induction coil is greater, and while the variations in resistance are only produced in the branches (carbons) of the derived circuit it happens that the variations of the current strength in the primary circuit of the induction coil are of the same order and magnitude as those produced when the shunt does not act, the switch being open.

There ought to be still another means of reducing the strength of current in the primary microphone circuit. This would consist in introducing in the circuit a given resistance R, Fig. 2. But one would thus obtain only one half the effects which the preceding arrangement gives. The loudness, it is true, would be diminished, but the clearness would suffer.

We may decide, therefore, either in favor of a shunt or of a combined shunt and resistance. Fig. 3 shows the latter arrangement diagrammatically. A three point switch replaces the switch of Fig. 1. When used for long distances the shunt circuit would be open and the resistance R would be short circuited. For local service the resistance R would be reduced in the microphone battery circuit, while the shunt circuit S would be closed around the carbons.

The employment of the shunt has given rise to very simple and inexpensive apparatus devised by MM. Mercadier and Anizan, of Paris, which can be readily combined with existing transmitters.

AN OLD LOADSTONE MAGNET.

We are indebted to Mr. John W. Howell, of Newark, N. J., for the history of an interesting relic of the days before Volta and Galvani, in the shape of a loadstone magnet.

This old magnet, reproduced in the accompanying engraving, is composed of a piece of loadstone with soft iron pole pieces fitted to it. One of the bands which hold the parts together is silver. On this band, is engraved: "Meinert (on side not shown) AParis, 1753; and on the pole pieces the letters N and S indicate the polarity. This polarity is, according to the French custom, marked S on the north seeking pole. The magnet weighs 2 lbs. 3½ oz. and will sustain more than its weight.

The magnet was brought to America about 1775 by Dr. John Francis Vacher, a French physician who was educated at the college of Montpelier. He joined one of the American regiments as surgeon and served for some time. He was a member of the Cincinnati, and is buried in St. Paul's churchyard in New York. It has been the plaything for his and his descendants' children for over one hundred years and its survival shows its good construction. It is now in the possession of the family of the late Hon. Robert Gilchrist who was a grandson of Dr. Vacher.

ELEC. ENG'R. N.Y.

A Loadstone Magnet of 1753.

STEERING BY TELEPHONE IN A FOG.

The London *Pall Mall Gazette* in a recent issue, describes the experiments of Mr. Charles A. Stevenson for locating the position of vessels at harbor entrances when, during certain states of the weather, other observations cannot be easily made. He proposes that a cable be laid in the sea, and the positions of vessels passing near or over it determined by means of a detector on board.

The first instrument used by Mr. Stevenson is a coil of uninsulated copper wire dipping into the water at the bow of the vessel and a similar water connection at the stern. These are joined by a wire with a telephone in the circuit, and a very sensitive instrument is produced. If the water connections are equidistant from the cable, as they would be if the boat were immediately over it, or lying broadside on, no sound is heard. The cable may be insulated or uninsulated and the action is similar with an induction coil.

With the coils separated ten feet (at the bow and stern of a small boat put down from the vessel) and an insulated wire 400 feet in length and laid through a small lake of brakish water fifteen feet deep, the alternations produced by a magneto-electric machine were perfectly distinct at the end of the lake 340 feet away from the wire, and the limit of audibility could not be ascertained.

Mr. Stevenson's second instrument is a coil of insulated wire surrounding a core and a telephone receiver in the circuit with the coil. With this instrument the making and breaking of the current produced through a wire 200 feet in length could be detected through 60 feet of salt water. The sound in a Bell telephone with the instrument was almost deafening with fifteen feet depth of water. This electromagnetic system of induction, in contradistinction to the parallel wire system, has no earth connection, being entirely insulated, and is therefore a case of true induction through water.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE BREMEN ELECTRIC RAILROAD.

THE success following the equipment of the Börse-Horn electric railway in Bremen by the Union Elektricitäts-Gesellschaft of Berlin decided the Bremen St. Railway Co. in equipping their entire lines with this system. This work is completed, so that there are now 10.3 kilometres of electric railway in operation; 6.5 kilometres being single track and 3.8 double track.

The power house is divided into three parts, consisting of engine room, boiler room and coal storage. It covers forty-four square metres of ground and is built of brick. The roof of the engine room is of iron and wood and that of the boiler and coal storage of corrugated iron. The chimney is thirty-six metres high. The equipment consists of two Babcock & Wilcox water tube boilers; three high speed McIntosh & Seymour engines and three Thomson-Houston dynamos of 80,000 watt capacity each, driven by belts direct from the engine shafts. Besides this, there are two steam engines and two Thomson-Houston arc light machines which feed the lamps in the Bürger Park about a quarter of a mile distant.

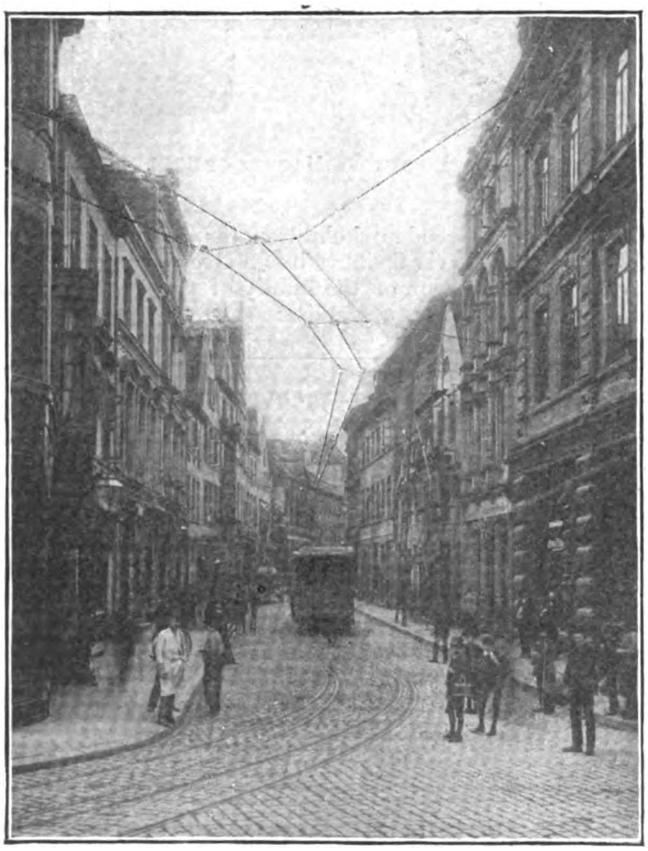


FIG. 1.—THE BREMEN ELECTRIC RAILROAD.

The Bremen Strassenbahn-Gesellschaft possesses at the present time twenty-five motor cars, eighteen running on week days and twenty-two on Sundays and holidays. Many of the old car boxes were remodeled and are employed on the present motor cars. Each motor car is equipped with a 15 h. p. W. P. motor with single reduction gear. The maximum speed permitted within the city is from 5½ to 7½ miles, and on the stretch towards Horn 7½ to 10 miles per hour. Each motor car is able to haul a tow-car.

The electrical equipment in Bremen proper is particularly noteworthy for the large number of sharp curves and turnouts in the streets through which it passes. The Bremen road demonstrates perfectly that in ease of starting and stopping the electric car is at least as well adapted to all streets, as is the horse car. The accompanying engraving, Fig. 1, shows the road at the entrance to the Sögestrasse in the Schüsselkorb. This particular spot is noteworthy because at that point a curve and a turnout occur in a very narrow street. Our engraving, Fig. 2, shows the car in front of the City Hall. The trolley wires are everywhere suspended by span wires fastened to neat rosettes attached to the houses. Guard wires or wooden fenders protect the lines throughout from falling telephone wires.

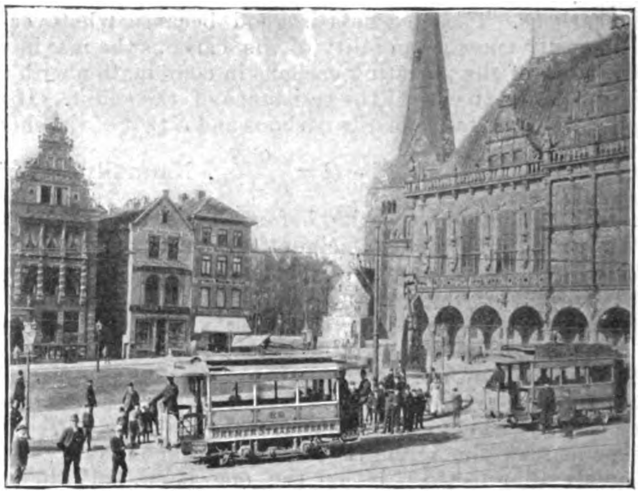


FIG. 2.—THE BREMEN ELECTRIC RAILROAD.

ELECTRIC CANAL BOAT TRACTION IN FRANCE.

FRANCE possesses a large number of canals which render very easy water communication between different parts of the country. Unfortunately up to the present time the hauling has been done most generally by men or animals. The time occupied was frequently very long, and, as a result, railway transportation has been preferred. It was, therefore, necessary to find a solution for this backward state of affairs.

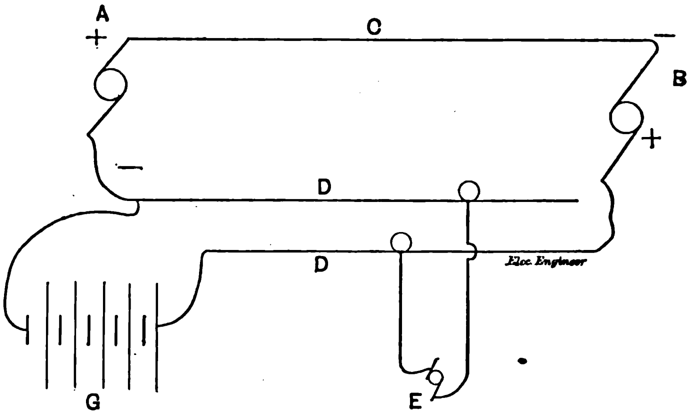


DIAGRAM OF CIRCUITS OF FRENCH ELECTRIC CANAL TOWING.

The first investigation with this end in view goes back to the year 1888, when M. Maurice Lévy made a number of experiments with cable hauling in the neighborhood of Paris, at the junction of the St. Maur and St. Maurice canals. The system was based on the employment of an endless wire cable on each bank, carried on supports provided with pulleys. The cable was operated by a fixed motor and to it the boats were attached by means of hauling ropes. This system gave a speed of four kilometers per hour. It constituted a considerable improvement on the existing methods but did not give entire satisfaction.

In 1890, there was talk of employing electric traction, and comparative plans were drawn up between steam and electricity. The first plans for steam were rejected as being too costly and impracticable; as for electricity one could find use for utilizing as motor power the water falls found on the route of the canals themselves. This idea was worked at for several years and finally towards the end of 1893 an installation of this type was put in on the Bourgogne Canal, which unites the river Yonne and the river Saône. Now the Yonne being an affluent of the Seine this canal establishes communication between the English Channel and the Mediterranean.

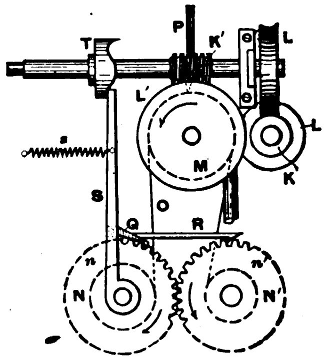
The installation has been established by the Department of Bridges and Roads for a length of six kilometres close to an underground tunnel 3.3 kilometres long. The motive power is obtained from water falls, having a fall of 7.5 metres in two successive locks. There are thus two generating stations established at the two ends of this junction canal. In each the turbine drives a Gramme dynamo, one running at 1,200 revolutions per minute and 380 volts, and the other at 900 revolutions and 270 volts. Each of the dynamos is appropriate to the conditions existing at the locks and the corresponding turbine. The dynamos are connected after the manner shown in the accompanying diagram. A and B are the two dynamos connected to a bronze overhead feeder of 8 to 10 mm. diameter, held by porcelain insulators mounted on poles. The dynamos are coupled in series. D D are the trolley wires and E, the towing motor. The latter revolves at 1,000 revolutions per minute.

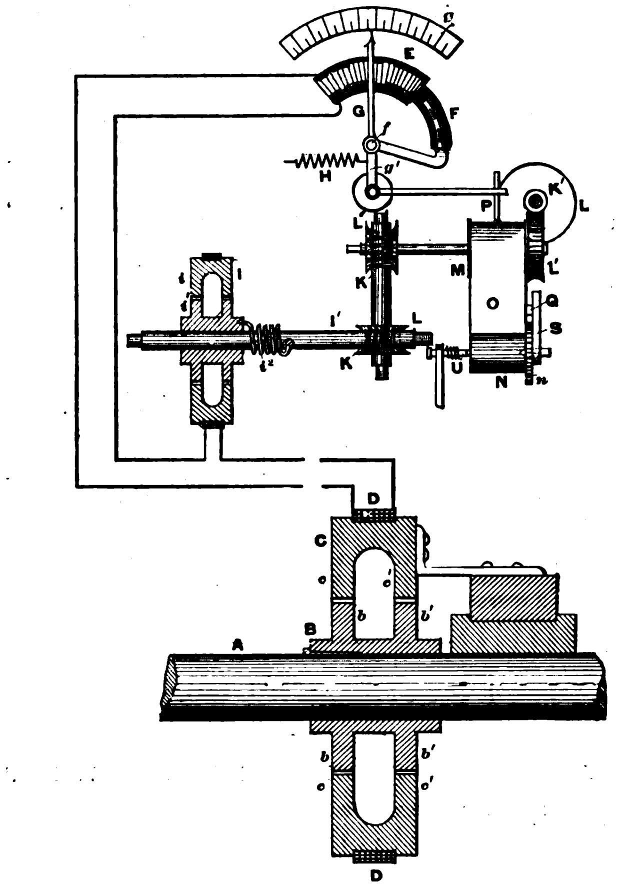
A storage battery of 250 cells, having a capacity of 150 ampere hours and a discharging current of 15 amperes, is coupled in parallel. These are Chloride batteries made by the Société pour le Travail Electrique des Métaux. The mean rate of discharge varies, according to the load, from 10 to 25 amperes at the potential above given. The stretch of six kilometres is covered in less than an hour.

Special arrangements have been made for the automatic regulation of the turbine. The water gates are opened or closed according to the power furnished by the machine. The tunnel of 3.3 kilometres mentioned is lighted by incandescent lamps which are branched in multiple on the power circuit. It may be said that this first electric canal installation has given such satisfaction that it is certain that before long this method will be largely employed in France, where canal locks are numerous.

HENRY'S RAILWAY SPEED RECORDER.[1]

This device was designed by Mr. John C. Henry, of Westfield, N. J., especially for use on locomotives, railway cars and the like, the object being to provide simple and reliable mechanism for indicating to an engineer or other official the speed at which the train is running, and also for making a permanent record of the varying rates of speed at which the train has passed over the road.





Figs. 1 and 2.—Henry's Railway Speed Recorder.

The generator or dynamo is mounted on or actuated by a shaft, A, preferably the locomotive truck, whose wheels are not liable to be slid on the rails by either the brakes or the steam pressure in the cylinders.

The dynamo is composed of a magnet, B, having an annular series of radial pole pieces, *b b'*, and keyed securely on the axle A. The magnet constitutes a rotating field. It is preferably a permanent magnet, as shown, though it may be an electro magnet if desired. Concentric with the magnet and surrounding it is the stationary armature C, consisting of a ring having radial pole pieces, *c c'*, projecting inwardly in the planes of the magnet poles *b b'*. A coil of insulated wire, D, is wrapped around the ring either externally or internally, and when the axle A revolves, an alternating current of electricity is generated in the coil. This current is led to any suitable electric indicator. The curved solenoid E, through which the current passes, and into which is sucked the core F, pivoted on a fulcrum, *f*, carries an index, G, which moves over a graduated scale or dial, *g*. A spring, H, resists the pull of the solenoid, and returns the index to zero when the current ceases. The intensity of the current varies directly with the speed of the axle A, and as the position of the index varies with the current strength, the variations in speed are instantly shown by the index. The current is also led to a motor, I, which may be in series or in shunt with the solenoid. It consists, preferably, of an annular field magnet, *i*, and a rotating permanent magnetic armature, *i'*, similar in construction to the dynamo. The armature is loose on the shaft, I', being connected therewith by a helical spring *i*² to ease the starting of the motor. The shaft I' is connected by suitable gearing, such as worms K and worm gears L, with the driving drum M of the recording mechanism. This comprises, in addition to the driving drum, two spools, N N', which pay out and wind up the paper ribbon O. The record is made on this ribbon by means of a pencil, P, which is moved transversely to the paper by an arm, *g'*, forming an extension of the index. The ribbon is ruled with longitudinal lines to indicate speed in miles per hour, and with cross lines to indicate predetermined intervals of distance run. The pencil traces a curved line, which enables one to see what speed was attained at any given point during the run, for how great a distance it was maintained, and what variations in speed took place. The spools are positively driven by the intermeshing gears *n n'*, engaged by pawls Q R, which are pivoted to a lever, S, actuated by a cam, T, on one of the shafts of the winding mechanism. The gears are operated by the pawl Q when the lever is moved in one direction by the cam, and by the pawl R when the lever is retracted by its spring *s*. The cam is so shaped that the lever is actuated and the gears rotated irrespective of the direction in which the axle, motor and worm shafts may be turning.

Since the motor is driven in synchronism with the dynamo, both having the same number of pole pieces, the revolutions of the recording mechanism vary directly with those of the axle A, though at a much reduced speed. The feeding of the paper is done by the worm K', which meshes with the gear L' on the shaft of the drum M. The spools N N' are held in frictional contact with the gears *n n'* by the spring bearing pins U, which afford a means for readily removing the spools when a new ribbon is to be inserted. The tendency of the gears is to wind the paper on to both spools N N', but since the spools have only a frictional contact with the gears, the result is that the paper is simply drawn tight over the drum M. The feeding is done wholly by the drum, and, in whichever direction it may be turning, the slack is taken up by the spool toward which the paper is fed.

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[1] *The Iron Age*. See Mr. Henry's letter in The Electrical Engineer, Feb. 21.

AN ELECTRIC ROAD FOR FLUSHING.

The Brooklyn City Railroad Company have applied to the Flushing, L. I., Board of Trustees for a franchise for an electric road between Brooklyn and Flushing.

ELECTRIC FREIGHT RAILWAY.

The Common Coucil of New Haven, Conn., have decided in favor of an electric freight railway to traverse the city streets and carry freight to manufacturing establishments. It is to connect with the Consolidated system near the Cedar Hill Junction.

THE CONEY ISLAND, FORT HAMILTON & BROOKLYN RAILROAD.

Articles of incorporation of the Coney Island, Fort Hamilton and Brooklyn Railroad have been filed in Albany. The capital is $500,000. The road is to be of the street surface order and five miles in length, and the directors are Patrick H. Flynn, John Mullin, John Murphy, Willis Brower, Alexander Walker, Peter F. Lyman, Michael Murphy, all of Brooklyn; Richard Berger, of Paterson; J. K. O. Sherwood, of Glen Head.

CHESTER STREET RAILWAY CONSOLIDATION.

Colonel Samuel A. Dyer, President of the Union Railway Company, has effected the consolidation of all the street railway systems entering the city of Chester, Pa.

The Chester Street Railway Company, the Chester and Media, the Chester, Darby, and Philadelphia, and the Union Railway Companies, all go under one management, to be known as the Chester Traction Company. This company will have a capital stock of $500,000, which, with the bonds of the companies consolidating, brings the total capital up to $1,000,000. The entire system will come under the management of Colonel Dyer, who holds the controlling interest in the Traction Company.

THE UNDERGROUND CONDUIT ROAD IN WASHINGTON.

A discussion occurred in the House of Representatives, at Washington, on March 12, relative to the adoption of the conduit system, the House having under consideration the bill (H. R., 6171) to authorize the Metropolitan Railroad Co. to change its motive power for the propulsion of its cars. Mr. J. H. Walker, of Massachusetts, was very eager for the insertion of the words "underground electric system," and made a hot attack on the trolley with a further onslaught on the wicked trusts, the General Electric Co. and the Westinghouse Elec. Mfg. Co., whom he accused of having tried by fair means and foul to prevent the conduit system from working. He was very forcibly opposed by Mr. Haines, of New York, who spoke as one who had been a street railroad man all his life and who had been actively connected with a score of trolley roads.

MISCELLANEOUS.

A UNIVERSAL SHUNT BOX FOR GALVANOMETERS.[1]

BY W. E. AYRTON, F.R.S., AND T. MATHER.

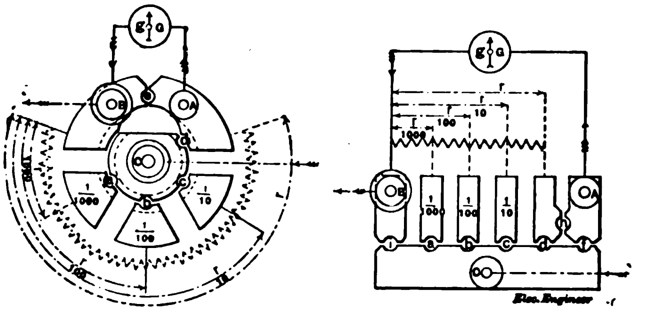
Several years ago Mr. Latimer Clark drew attention to the fact that when shunts were used with a ballistic galvanometer in the comparison of the capacities of condensers, the results were inaccurate if the multiplying powers of the shunts were assumed to be the same as those employed with steady currents; shortly afterwards the matter was investigated mathematically by the late Mr. Hockin, and he showed that the inaccuracy was caused by the change which the application of the shunt produced in the damping of the swing of the ballistic galvanometer. Hence the instantaneous deflection of a galvanometer when shunted showed an extra diminution, as if its resistance had been increased.

In 1892, when giving a preliminary account of our "workshop ballistic galvanometers" at the Physical Society, we incidentally mentioned a method that we had devised of constructing shunts which entirely overcame this difficulty. At that time we had only perveived that our method of constructing *constant-damping* shunts was of value in connection with ballistic galvanometers; but subsequently it occurred to us, when specifying the resistance of such constant-damping shunts, that this method of construction not only removed the difficulty which had been pointed out by Mr. Latimer Clark in connection with ballistic galvanometers, but it enabled the same shunt box to be used with any number of different galvanometers of any resistance and of any type, and with an accuracy in the measurement far greater than could be obtained with the ordinary form of shunt box which had been specially constructed for the particular galvanometer.

The common, well-known method of constructing shunts possesses several defects all arising from the fact that the method hitherto adopted of varying the current through a galvanometer while the current in the main circuit remained the same, has consisted in varying the resistance of the shunt to the galvanometer. If, however, we leave the shunt to the galvanometer untouched, and, instead, vary the current through the galvanometer by varying the point of attachment of the main leads, we remove all these difficulties at once.

A shunt box constructed in this latter way is seen in Fig. 1. The terminals A and B of the shunt box are permanently connected, respectively, with the terminals of the galvanometer G, while the terminals B and C of the box are connected with the two main wires which lead the current up to, and away from, the galvanometer and shunt. The ends of a coil of *any* resistance r ohms are permanently connected as shown, and at points in this coil corresponding with $\frac{r}{10}$, $\frac{r}{100}$, $\frac{r}{1,000}$ ohms permanent connections were made with the various blocks of the shunt box as illustrated.

Then, whatever be the resistance of this coil r, compared with the resistance of the galvanometer g (either, or both, of which may therefore be unknown), it is easy to show that if G amperes be the current flowing round the galvanometer when a plug is placed in the hole marked d, it will be $\frac{G}{10}$, $\frac{G}{100}$, and $\frac{G}{1,000}$ amperes respectively when the plug is put instead into the holes marked c, b and a, respectively, provided that the current in the main circuit remains constant—the condition which is, of course, assumed to be true in the ordinary use of shunts. Or, if a definite quantity of electricity flow into or out of a condenser in the main circuit, and Q coulombs be the quantity of electricity that flows round the galvanometer when the plug is in the hole marked d, $\frac{Q}{10}$, $\frac{Q}{100}$, and $\frac{Q}{1,000}$ coulombs will be quantities that flow round the galvanometer when the plug is put into the holes c, b and a, respectively, and the deflections will correspond with these quantities.



FIGS. 1 AND 2.

Similarly, if K be the number of coulombs flowing into, or out of, a condenser in the main circuit, and pK, or Q be the number of coulombs that flow round the galvanometer when the plug is put into the hole marked d, it is true that since the resistance of the galvanometer plus that of the shunt is constant and therefore the damping is constant, the quantities of electricity that will flow round the galvanometer when the plug is put instead into the holes marked c, b, a, respectively, are $\frac{Q}{10}$, $\frac{Q}{100}$, $\frac{Q}{1,000}$ coulombs.

Hence the galvanometer may be wound with copper or with any other wire; a single set of shunts may be made of manganin wire, and be accurately subdivided into exact numbers of ohms, fractions of an ohm being unnecessary with our system; the galvanometer may have any resistance and be at any temperature, provided it is constant while a set of tests is being made,—then the sub-division of a steady current or sub-division of an instantaneous rush of electricity into parts having the ratios of 1, $\frac{1}{10}$, $\frac{1}{100}$, $\frac{1}{1,000}$, is effected with great accuracy.

The arrangement of shunt box illustrated in Fig. 1 may be regarded as possessing one defect—viz., that the whole current flowing in the mains cannot be sent round the galvanometer without disconnecting the main wire from the terminal C, and connecting it instead with the terminal A. To save the trouble of having to do this. and to enable every combination to be made by simply shifting the plugs. we sometimes construct the blocks of the shunt box as seen in Fig. 2. When one plug is placed and left in the hole marked *h*, and a second plug is placed in one or other of the holes marked *d*, *c*, *b*, or *a*, we obtain exactly the results already described in connection with the box seen in Fig. 1. Placing, however, one plug only in the hole marked *f*, the entire current flowing in the mains circulates round the galvanometer. If a plug be placed in the hole *f*, and another in the hole *j*, the galvanometer is short-circuited—a result obtained by placing the two plugs in the holes marked *d* and *e* in Fig. 1. The arrangement shown in Fig. 2 has the further advantage that it is possible, by putting a single plug into the hole marked *j*, to disconnect one terminal of the galvanometer from the circuit without breaking the circuit. This method of connecting is convenient to employ when taking the zero with a very sensitive galvanometer, for in that case it may happen that, although the galvanometer is apparently short-circuited through a very low resistance, enough of the main current, although but an extremely small fraction, passes round the galvanometer to produce a small deflection.

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[1] Abstract of a Paper read before the Institution of Electrical Engineers, London, March 29, 1894.

When, however, r is more than about ten times as great as g, the simpler form of shunt box illustrated in Fig. 1 is sufficient for ordinary purposes; for, although by merely shifting the plug with this type of box, it is impossible to send a greater current round the galvanometer than $\frac{r}{r+g} A$ amperes, where A is the current in the mains, this value of G, being more than $\frac{10}{11} A$, is sufficiently near A for ordinary purposes.

Of course, whatever be the value of r, whether large or small compared with that of g, the current that flows round the galvanometer when the plug is put into the holes marked c, b, and a, respectively, is exactly 1-10th, 1-100th, and 1-1,000th of its value when put into the hole marked d. The only advantage that is gained by making r large compared with g is that $\frac{r}{r+g} A$, or G, the unit current, becomes then practically equal to A.

The method of using shunts above described has, then, the advantage that it enables the same shunt box to be used with any galvanometer of any resistance, whether ballistic or not; but it does more than that, for a consideration of our method of varying the point of attachment of one of the mains, instead of varying the resistance of the shunt itself, shows that any ordinary resistance box can be employed as a shunt with any galvanometer, and the fractions of the current that pass round the galvanometer and through the shunt, respectively, can be read off at once, without any calculation and without a knowledge of the resistance of the galvanometer, to a far higher degree of accuracy than is possible with a set of shunts specially constructed for the particular galvanometer in the ordinary way.

By employing this device we also find that great simplification and cheapening of cost is effected in the employment of a d'Arsonval galvanometer with shunts of platinoid or manganin sheet for the measurement of electric currents over a wide range.

THE ELECTRIC LIGHTING QUESTION AT WAVERLY, OHIO.

THE citizens of Waverly, Ohio, are so strongly in favor of municipal lighting that the local political campaign of that town seems to be based solely upon the subject. The citizens have addressed to the candidates of both parties for Mayor and Council a letter of which the following is part:

> Are you in favor of an electric light plant for Waverly? Are you in favor of the proposed issue of bonds to build an electric light plant here at Waverly? Will you labor, if elected, to secure the establishment of an electric light plant for Waverly?
>
> The single words, "yes" or "no" is all that is required over your own signature. And as there remains yet one week before election, and one issue of the local papers before election, it is expected that these questions will be answered next week. And it is to be further understood that any candidate failing to answer through the columns of the local press, is to be interpreted as opposed to an electric plant.

ELECTRIC LIGHTS FOR BISMARCK.

PRINCE BISMARCK is having the electric light installed in his castle at Friedrichsruhe, the work being carried out by the Hamburg branch of Messrs. Schuckert & Co., of Nuremberg. Power for driving the dynamos will be obtained from a saw mill in the Sachsenwalde, a short distance from the castle.

ERRATUM.

IN Mr. Thomas Ewing, Jr.'s interesting article on "The Patent Office" in our issue of last week, the second word in the 25th line from the foot of the second column of page 304 should be "many" instead of "any," as printed.

APPARATUS FOR THE TAKING OF ALTERNATE CURRENT CURVES.

BY NELSON H. GENUNG.

Joubert is supposed to have made the first real reproduction of alternate current curves by employing a contact point rigidly attached to and revolving with the armature of the generator, and adjusted so as to make connection with a fixed brush once in each revolution. By this means, he charged a condenser to the voltage of the generator at some definite and known part of the period. Some time after this, curves of E. M. F. and current in both the primary and secondary of induction coils were taken by Dr. Louis Duncan and others, the above mentioned contact device being employed.

In order that the exact workings of a transformer may be known, the instantaneous values of current and E. M. F. in both circuits must be simultaneously picked out and measured at definitely known positions throughout a complete cycle, and the results plotted. Professor Ryan was the first to undertake the practical carrying out of a piece of work of this kind, and the numerous papers published by him and his associates in the year 1890, containing an enormous amount of valuable experimental data, have given us exact knowledge as to the relative phases of current and E. M. F. on commercial apparatus working under various conditions, which, up to that time, had been a matter of pure guesswork. Thus, both theoretically and practically, the transformer as to its working conditions was placed on a perfectly definite basis. In other words, "transformer indicator diagrams" have done for the transformer what the characteristic curves have done for the continuous current machine, and what the indicator card has done for the steam engine. Prof. Ryan in his work employed necessarily the contact maker and an electrometer of his own design. Many others have since employed essentially the same outfit in continuing these valuable investigations. Aside from this, alternate current working has of late become so prominent a feature of electrical engineering, that in many of our leading technical schools, the taking of transformer curves by the instantaneous contact method has come to form a part of the prescribed laboratory course.

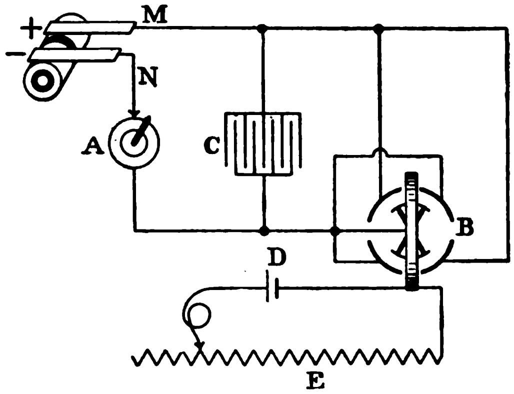

FIG. 1.—CONNECTIONS FOR OBTAINING ALTERNATE CURRENT CURVES.

The arrangement of contact maker and electrometer as employed by Prof. Ryan and others, is essentially that shown in Fig. 1. The wires M and N come from a switch so arranged that pressures from different circuits may be conveyed to the electrometer through the contact device A. Values of current are obtained by measuring the fall of potential around a non-inductive resistance of known value through which the current is made to flow.

The condenser shown at C, has usually been found necessary to obviate the effect due to leakage of the electrometer, the latter being of extremely small capacity and the circuit being closed through the contact points for but a very small fraction of each revolution.

The electrometer, as designed and improved by Prof. Ryan with the purpose in view is shown in Fig. 2. This instrument, not so perfected, was employed by Prof. Ryan in his earliest work on transformers, and has ever since been employed by him and many others almost exclusively in work of the same, or of a similar nature. The quadrants are here mounted on quartz plates to insure high insulation, thus rendering the use of a condenser seldom if ever necessary, and are faced with mica so as to prevent short circuiting should the needle accidentally touch them. The cover plates carrying the quadrants are held accurately in position by spring clips and pins and the opposite quadrants are connected automatically by metal strips. A small magnetic needle is rigidly attached to the system and situated exactly at the centre of the circular case on the outside of which are wound two coils of a different number of turns, which, together with the binding

(*Continued on page 328.*)

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. **Cable Address: LENGINEER.**

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
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New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - -	per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies, - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April* 9, 1888.]

Vol. XVII. NEW YORK, APRIL 11, 1894. No. 310.

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THE GENERAL ELECTRIC REPORT.

THE second annual report of the General Electric Company, to January 31, 1894, is printed elsewhere in this issue. Its salient feature—shown in the balance sheet—is the conversion of a surplus of $1,024,954.59 (Report of January 31, 1893) into a profit and loss debit of $12,454,967.42—a loss, or shrinkage of net assets of $13,479,922.01. In view of the history of the company this result surprises nobody. All competent observers have long been aware of the excessive value placed on some of the company's assets in the report of a year ago. It is gratifying to find this admitted by President Coffin, who explains the difficulties that "led to grave mistakes in the estimates of value of accounts, securities and inventories of merchandise." In fact, the report is largely devoted, properly and necessarily, to accounting for the prodigious shrinkage of the assets as they were given in the balance sheet of the year before; for all of which the reader is referred to the text of the report.

Although the pruning hands of the newer and more conservative men in the board of directors can be plainly discerned in the valuations of some of the assets, the inordinate sum of $8,159,264.00 still stands for "patents and franchises," as last year; that is to say, expenditures for patent rights and patent litigation during the year have been charged to operating expenses; but the directors have not had the nerve to whisk out of sight the bulk of that $8,159,264.00 of ghostly property, although the patents have a year less to run, and the Edison lamp patent has apparently but a few months of life before it. The company's counsel, however, are "hopeful that the courts will so construe the law that the lamp patent will run for the full term for which it was granted, in spite of the fact that the situation is somewhat complicated by foreign patents."

Of the rest of the report there is not much to be said. It exhibits a large reduction of indebtedness, some $6,750,000.00, on both direct and contingent obligations (endorsements). The funds required for this reduction were obtained from the sale of securities to the trust known as "The Street Railway and Illuminating Properties"—$4,050,000.00—and from collections—$2,700,000.00. The transaction with the trust was made at a large reduction from the book values of the securities sold. The company has apparently gone a good way in wiping out fictitious values, except as to patents; whether it has gone far enough in that direction remains to be seen in the results of another year. It is quite clear that a very great improvement has been effected in simplifying and compacting the manufacturing and business departments of the company and in its executive organization. The changes made during the year may be expected to result in increased efficiency and material reduction in operating expenses. A consistent carrying out of the policy of selling its products for cash or on short time credits—abandoning the promotion of local companies through investments in their stocks and bonds—ought to protect the stockholders in the future from much of the disastrous collapse of values in the company's assets that has characterized its history since its organization two years ago.

In general, the present report may be said to indicate that the directors have begun to recognize the company's limitations, and to perceive that the colossal scheme of inflation and monopoly undertaken in April, 1892, has proven a will-o'-the-wisp.

THE POPULARITY OF THE TROLLEY.

A decision was made by the Chicago city council last week which threw open a large portion of the Western metropolis to occupancy by the trolley, in spite of the fact that the ordinances had been disapproved by the mayor. The result is that some thirty miles of street on the South Side will be equipped with overhead wires as soon as the work can be done. Curious to note, the vote was given because the public wanted it. More than one councilman said he voted to sweep aside the veto because his constituents demanded that he should do so. "We have come here to legislate for the people we represent. I am going to move the passage of that ordinance because my people want it." Under such circumstances, it is no wonder that the vote stood 51 to 11. As far as we can discover from the city papers, there is no genuine public sentiment against the trolley, and a very strong feeling in its favor.

It is at least significant that almost at the same hour when the Chicago council was thus voting so overwhelmingly for the trolley, the *New York Tribune* which had hitherto, in company with the *New York World*, signalized itself by publishing some ridiculously extravagant attacks on the trolley, manifested a change of front and came out with utterances of a far more sensible and reasonable nature, giving the trolley some credit for being a great and useful modern servitor of the public. This is another good sign. In due time we may hope for a similar exhibition of cool judgment and sanity on the part of other railers in high places—such men, for example, as the Hon. J. H. Walker, of Massachusetts, who delivered recently in the House of Representatives a wild speech against the trolley, raving idiotically about the builders and owners of trolley roads as a "cruel, heartless, remorseless combination of interests that has no regard for human life or the comfort of citizens." Speaking of such concerns as the General Electric and Westinghouse Companies, he alleged that "these great dominant unprincipled combines have pursued this (conduit) system with the malignity of the infernal regions." Nay more, this "monstrous devil fish," has not merely perpetrated direct mischief, but "has in its pay every electrical engineer of this country, retained in its own cases, who is of sufficient reputation to have his head at all above the common level of electrical engineers; and you cannot get an opinion out of any one of them."

We do not know what Mr. Walker's politics are, and don't care; but if his other views and opinions are as false and far from the facts as these, it is to be hoped that his career in Congress will be very brief. It is not easy to impeach a nation; nor is it easy to traduce a whole profession. If Mr. Walker assumes to promote the cause of the conduit railway as opposed to other electric methods, he is on the wrong tack; his insane violence leads one to believe that he is in truth an enemy of the cause he professes to advocate. As against his frothy foolishness, we will simply oppose a few statements of facts. He has abused the Westinghouse Co. At this very moment, Mr. Geo. Westinghouse, Jr., is engaged in elaborate and costly experiments to perfect a new conduit system. Mr. Walker has massed together the competent electrical engineers of the country as having sold themselves body and soul for fees or bribes. Well, some Congressmen may do that, but in the professions, the man who sells himself has so low a standing that he loses caste at once. Because a man is retained as an expert he is not necessarily dishonest. But coming to matters of fact we may state that a great many of the most prominent and able electrical engineers in the country are busily engaged in working out conduit systems. Indeed, electrical engineers are far more anxious to reach the conduit goal than the public are to see them get there, because they realize the magnitude of the prize at stake, and want to win it. In this city alone, the Metropolitan Traction Co. has offered an award of $50,000 for such a system and has been literally inundated with ideas and propositions from electrical engineers. Moreover, as Mr. Walker himself intimated, one or two inventions give promise of ultimate success. But shall we blame men who have invested huge sums in trolleys if they go slowly before they adopt a new method? The Constitution of the United States is itself against sudden, revolutionary changes, and they are no more to be expected or sought in the arts and sciences than in political economy. Mr. Walker may be a New England manufacturer, though his calibre throws doubt on the suggestion; but if he is, we venture to affirm that he would be the last man to change the old machinery in his factory for new, at the bidding of a blatherskite, or until he had fully satisfied himself that the change was warranted by every consideration of prudence and propriety.

The conduit electric railway system will go steadily forward in the line of improvement, and we expect and hope soon to see some brilliant demonstrations of success in that field in America, where all the conditions are so severe and exacting. But the trolley system also will go on improving, and will subserve the necessities of a very large number of our American towns and cities. Neither the trolley nor the conduit will, or can, reign supreme; the one will but be the complement of the other, to the end of the chapter.

SOCIETY AND CLUB NOTES.

BROOKLYN INSTITUTE.—DEPT. OF ELECTRICITY.

A regular meeting of the section was held last week, when Mr. J. Hamblet presided and read an interesting paper on "Pendulums and Escapements." He was succeeded by Mr. J. H. Gerry, who spoke on the subject of "Electric Signals and Programme Clocks," and also described the extensive clock system at the World's Fair. The talks of the evening were fully illustrated by a number of mechanical lantern slides showing escapements at work, and by some views of the World's Fair.

OBITUARY.

PAUL JABLOCHKOFF.

The death is announced of Paul Jablochkoff, the distinguished Russian inventor and electrician to whom is due the arc lamp that bears his name. He was born in 1847, began active life in the Russian military and telegraph service, and from about the year 1871 began to take deep interest in electric lighting. In 1877–8, he brought out the famous "Jablochkoff candle" in Paris, by means of which in May 1878, the Avenue de l'Opéra was brilliantly lighted. The Jablochkoff system was simultaneously introduced all over Europe and in this country, and did much to stimulate public interest, though it soon gave way before better methods and better apparatus. Mr. Jablochkoff made a number of interesting inventions, but will always be best known by his "electric candle" and his early appreciation of the great value of the alternating current for lighting, etc.

(*Continued from page 325.*)

posts for the same, are completely insulated by means of hard rubber. The instrument may be used in one or two ways; either the E. M. F. may be calculated from the deflections produced, or a zero method may be employed, the needle being returned to zero by means of a current in one or both of the coils acting on the magnetic needle at the centre. The latter method is the more accurate and is entirely free from errors due to variations in the earth's field. The voltages are with this latter method determined in terms of the current flowing in the coils surrounding the case. The strength of current flowing may be regulated and its values determined very conveniently and accurately by the combination of a standard cell and known resistances, as shown in Fig. 1, and as employed by Prof. Ryan.

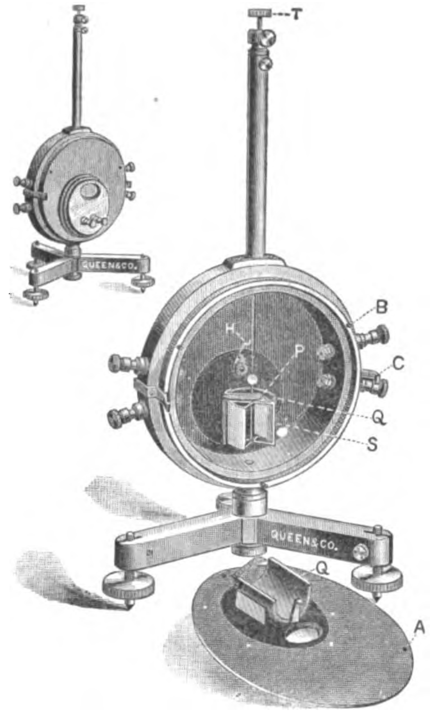

FIG. 2.—RYAN ELECTROMETER.

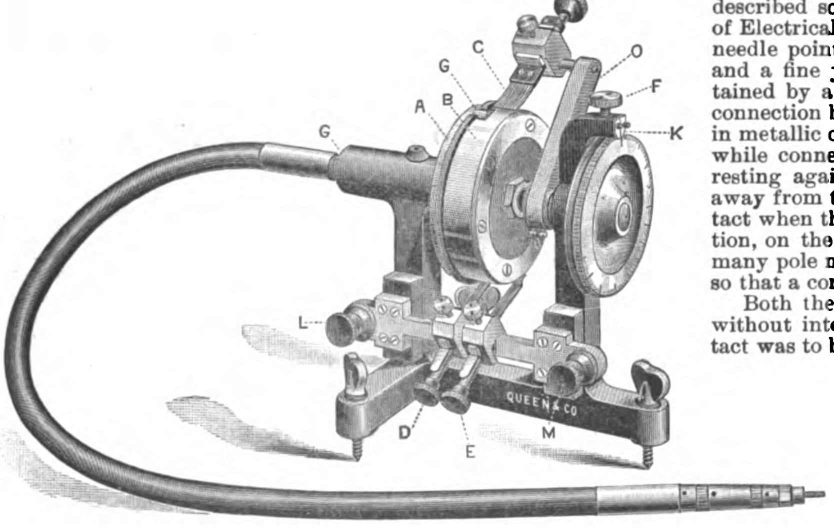

FIG. 3.—CONTACT MAKER FOR OBTAINING ALTERNATE CURRENT CURVES.

The contact maker which is to accompany this or whatever other measuring device it may be desired to employ, is shown in its most complete form in Fig. 3. The metal base carries a revolving ebonite cylinder driven by means of a flexible shaft, very rigid, so far as torsion is concerned, easily attached to the end of the armature shaft, as shown in Fig. 4, thus making perfect alignment of the contact maker unnecessary. Brushes connect the insulated binding posts to two brass rings on the circumference of the hard rubber cylinder. The steel knife edge plug G attached to ring A may be adjusted so as to just touch at each revolution the sharpened end of a piece of piano wire forming a part of the third brush O which presses continuously against ring B. This brush, as shown, may be accurately set and clamped in any desired position with reference to the armature shaft by means of the finely divided scale at the end. This arrangement of brushes and rings avoids the use of flexible connectors which are more or less apt to become entangled in the rotating parts. All parts necessarily handled in the course of the work are perfectly insulated, so that the operator may run no risk of coming in contact with the live circuit.

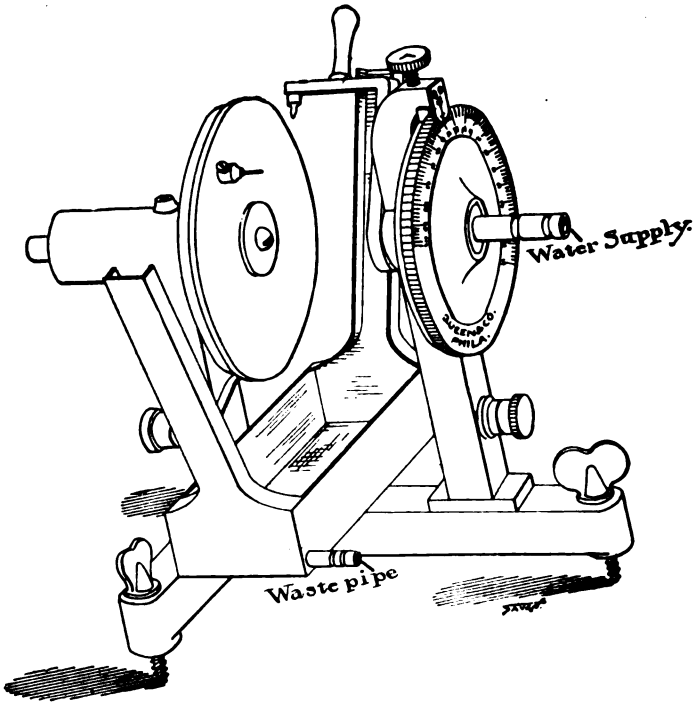

FIG. 5.—RYAN AND BEDELL JET CONTACT MAKER.

A contact maker of a somewhat different design was recently worked out jointly by Professors Ryan and Bedell, and was fully described sometime since at a meeting of the American Institute of Electrical Engineers.[1] It differs from the other form in that a needle point is substituted for the steel plug, as shown in Fig 5, and a fine jet of water for the third brush, the jet being maintained by a small reservoir of water a few feet above the nozzle, connection being made by a flexible rubber tube. A binding post in metallic communication with the nozzle serves as one terminal while connection with the needle point is made through a brush resting against the revolving disc. The nozzle points slightly away from the disc, so that there is no possibility of a second contact when the projecting needle point is in the course of its revolution, on the opposite side of the disc. Should the generator be a many pole machine, more than one contact point may be inserted, so that a contact may be had with each cycle if desired.

Both these forms of contact maker have been run for hours without interruption, during all of which time a fine sharp contact was to be had.

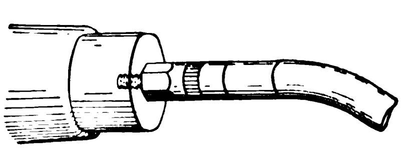

FIG. 4.

ELECTRICAL MARBLE.

It is said that Mr. H. Le Chatelier, the French chemist has succeeded in producing marble from pure calcium carbonate by reducing the latter to an impalpable powder, subjecting it to a pressure of 2,000 pounds to the square inch and heating it by means of a platinum wire kept in a state of incandescence by the electric current.

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[1] See THE ELECTRICAL ENGINEER, November 8, 1893.

LETTERS TO THE EDITOR.

THE BOILERS IN THE MILWAUKEE STATION.

In your issue of March 14th, there appeared an article on the central station plant of the Milwaukee Street Railway Company, by Mr. Otto Frick. The writer states that at the time of adopting the Galloway boilers, they were the only ones on the market capable of supplying steam at a working pressure of 160 lbs. per square inch.

As I was personally identified with the preparation of the plans and specifications for this plant, I respectfully inform you that there were several other boilers on the market that would have fulfilled the requirements. Propositions were secured on several other boilers. J. H. VAIL.

NEW YORK, March 30, 1894.

INFORMATION ON INCANDESCENT ARCS.

In THE ELECTRICAL ENGINEER of March 28, "*R. W.*" states: "In the ordinary arc lamp, where the carbon points are exposed to the atmosphere, I have always understood that the incandescence of the carbon particles, detached from the positive carbon aided materially in producing a bright light. In the 'incandescent arcs' where the destruction of the carbons is so slow, and there is little carbon vapor, does the same length of arc produce an equivalent amount of light? Also, the carbon vapor being a semi-conductor, is not a greater E. M. F. required to maintain a given length of arc in the closed lamp, where it is (practically) absent, than in an open lamp, where the vapor is present?"

In reply I would say, that the conditions which govern the relations between P. D., length of arc and radiant efficiency of an arc enclosed in a small bulb such as referred to by "*R. W.*," differ from those governing an arc in open air. Absence of oxygen on the one hand, and the temperature and tension of the enclosed gases on the other, introduce a new set of phenomena. This subject was treated of at some length in a paper read before the International Electrical Congress, at Chicago last August. (See THE ELECTRICAL ENGINEER, Aug. 30, 1893, pp. 193, 194, 195, 196, 207).

Regarding "*R. W.*'s" first question, "Does the same length of arc produce an equivalent amount of light," I may say that this relation depends upon the specific length for a given current and P. D. With small P. D.'s the result will be in favor of the open arc; with relatively large P. D.'s, in favor of the "incandescent arc." This may be inferred from the curves and tables p. 194, of the article above referred to. The other question is answered on p. 195, under the head, "Relation of P. D. to length of arc and quality of carbon." An enclosed arc may be maintained with a smaller P. D, than an open arc of same length. "*R. W.*" will find, I think, that his conclusions are based on erroneous assumptions. L. B. MARKS.

NEW YORK, March 30, 1894.

HEAVY GASES IN INCANDESCENT LAMPS.

YOUR editorial résumé of the proceedings of the last Institute meeting gives a very excellent digest of my paper and the discussion following. Allow me to say a word in relation to Mr. Howell's criticisms.

First: The lamps of which results were reported by Mr. Howell were professedly special lamps. Maintaining, as they did, their candle power and efficiency, they could not have appreciably blackened. I have never seen on the market, vacuum lamps of 3 or 3.5 watts per candle either 50 volt or any other, that would run 100 hours without considerable blackening.

Second: As to the quality of the vacuum lamps referred to in my paper,—they were made from standard filaments, were thoroughly exhausted, and if they were poor lamps I have seen much poorer ones in commercial use.

Third: A test of eight lamps would not be a fair basis for generalization as to the general product of a factory, but as a comparative test between bromine and vacuum, the results warrant all my conclusions.

The well-known scientific method of making comparative tests, of varying only the condition whose effect it is the purpose of the test to determine, was rigidly adhered to. The filaments were taken from the *same* "*batch*." Everything in the construction of the lamps was the same up to the point of exhausting. Then half the lamps were taken *at random*, and exhausted as vacuum lamps, and the other half treated as bromine lamps. They were run as nearly as possible under the same conditions as to initial efficiency. The individual lamps of each class gave results differing very little from the means as given in Table III. of the paper. Every individual vacuum lamp blackened and lost its efficiency about as shown in the table. Every individual bromine lamp remained perfectly clean, and maintained its efficiency. Under the conditions I consider that it is perfectly fair to conclude that the observed difference in results was due to the presence of bromine in one set, while in the other was a vacuum. I believe the filaments used in these lamps were not poorer than the average which the public has to use.

Fourth: It was not my object in the paper to show what could, or could not, be done in the improvement of vacuum lamps. If the General Electric Co. can make filaments that will give such results as to maintenance of candle power and efficiency as those reported by Mr. Howell, and can furnish such lamps commercially, I shall be with the first to congratulate them. My object was to show that the blackening which, according to my experience, was a serious evil in all high efficiency lamps, could be avoided without serious shortening of the life, by the use of bromine gas.

Fifth: 50 volt lamps were used because such lamps form a considerable portion of the product of the Waring factory and such filaments happened to be available at the time. Comparative tests on 110 volt lamps performed under abnormal conditions similar to those reported in Tables I and II give precisely similar results.

In my house in Manchester, Conn., I used 115 volt (about) Edison and bromine lamps and the bromine lamps maintained their candle power while the Edison lamps failed in a most annoying manner.

Sixth: As to the shadow in the carbon deposit. It simply shows that we may obtain a sufficient vacuum and a sufficient vapor tension to produce it. As I said in my paper I attach no importance to this phenomenon. It does not alter in any way the conclusions which I reached. WM. A. ANTHONY.

VINELAND, N. J., April 2, 1894.

PERSONAL.

MR. PAUL T. BRADY, until recently agent for the General Electric Co. in this State has resigned and now has an office at Syracuse, N. Y. as local manager for the Westinghouse Elec. & Mfg. Co. in that section of the country. It is not to be doubted that his former success will still attend him.

DR. SCHUYLER S. WHEELER, the expert of the N. Y. Board of Electrical Control has a signed editorial article in the *Morning Journal* of April 1, dealing with "Electric Wire Perils." He looks forward to a speedy arrival of the time when the laws of electrical action will be better understood and when people will be indifferent to the present very sensational treatment of the "dangers" of electricity. The recent alleged blinding of a man in Brooklyn by a trolley flash he characterizes in his own blunt way as a "fake."

MR. W. A. GRANT, general manager of the Niagara Falls Park and River R. R. has resigned that position to become assistant to vice-president Shaughnessy of the Canadian Pacific R. R. It will be remembered that Mr. Grant made a great success of his road at the Falls, which carried last year, between June and December 416,000 passengers, and is now to be double tracked. His executive ability will now have a wider field of display. Mr. Grant is succeeded by Mr. Ross McKenzie, who is an old and experienced railroad manager. The road was recently inspected by President Van Horne under Mr. Grant's guidance.

MR. GEO. P. LOW, of San Francisco, has been appointed Consulting Engineer for the Board of New City Hall Commissioners of that city. The San Francisco City Hall is an imposing structure which has cost $20,000,000, and Mr. Low has been engaged as designing and supervising engineer for the installation of an electric lighting plant therein. It is stated that the probable capacity of the proposed plant will be 6,000 incandescents and 50 arcs. Mr. Low is well known as the Electrical Inspector of the Pacific Insurance Union, as a member of the Electric Committee of the Underwriter's International Electric Association, and as Vice-Chairman of the Section of Pure Practice of the World's Congress of Electricians, at Chicago, in 1893.

THE THOMSON RECORDING ARC WATTMETER.

In an article on the "Thomson Recording Watt Meter for Arc Circuits" printed in our issue of March 14, it was stated that the safety cut-out "is designed to close immediately on trouble occurring within the meter." This should have read: "The cut-out is designed to close in case of any trouble on the circuit which the meter is measuring. On closing, this device cuts out both the meter and the lamps upon it and serves not only as protection to the meter but to the lamps it is measuring. A rise in potential around the lamps which are being measured, sufficient to cause trouble, will throw this cut-out into action, and absolutely preclude any danger to the meter or its circuit."

REPORTS OF COMPANIES.

SECOND ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY, JANUARY 31, 1894.

Before considering the present condition of your Company, your directors deem it proper to revert to its situation a year ago. It is believed that by so doing, a clearer statement of the existing condition of your Company can be made.

Your Company represents a practical union of the Edison Electric Light Company, the Edison General Electric Company, the Thomson-Houston Electric Company, and the Thomson-Houston International Electric Company.

To acquire these Companies, your Company issued the following securities (except as to $100,000 of its common stock which was issued for cash):

Common stock	$30,459,700
Preferred stock	4,251,900
	$34,711,600
Subsequently it sold for cash its 5% Debenture Bonds amounting to	10,000,000
Total	$44,711,600

Of this amount, $8,159,264.02 was shown in the last report, as representing the cost to the General Electric Company of the Edison and Thomson-Houston patents and contract rights, and your interest in the patents of the Brush, Fort Wayne, and other allied companies.

On January 31, 1893, your other assets were examined and valued, and a report on the condition of your Company was made to the stockholders at their annual meeting in April last. This examination was conducted under rigid instructions from your Board of Directors, that material on hand, stocks, bonds, customers' notes and accounts, etc., should be carefully scrutinized, and should be valued on a most conservative basis. The complex organization then existing (referred to further on in this report) and the fact that the amalgamation of the various interests represented by your Company had been so recent, made the task an especially difficult one at that time, but the statement made by those directly responsible to the Board, was, that the instructions of the Directors had been strictly carried out.

Your Company had inherited stocks of manufactured goods in the principal cities in which District offices were located, from Boston in the East, and Atlanta in the South to San Francisco and Portland in the West. Notes and accounts receivable, stocks, bonds, and other assets were similarly distributed. Each District Office had exclusive charge of, and was presumably familiar with, the value of its own assets, and was largely independent of the General Office. This defective system, since abolished, rendered it exceedingly difficult to arrive at correct conclusions, and notwithstanding the efforts of the officers, it led to grave mistakes in the estimates of value of accounts, securities and inventories of merchandise.

The Edison Company, to a small extent, and the Thomson-Houston Company (the organization of which was mainly adopted by your Company), to a greater extent, had been in the habit of doing more or less exploiting work, resulting in the acquisition of stocks and bonds of local lighting and railway companies. The Thomson-Houston Company had generally been very successful in marketing these securities at profitable figures. By the facilities which it had thus been able to afford to local enterprises, it was enabled to expand its business. Your Company at the time of its organization assumed a large number of such transactions which were in progress or contracted for. The general policy of your Board, however, since the organization of your Company, has been to curtail transactions involving the acceptance of stocks or bonds for anything other than license rights, except where for some special reason it has been deemed advisable to accept them, as in settlement of disputed or doubtful accounts.

Among the most important transactions of the character above referred to were those with newly organized companies, and this class of business had been very extensive in the South and West. The financial and industrial collapse in these sections in the Spring and Summer of 1893, affected your Company severely, and very many accounts, notes and investments assumed as good a year ago, must now be recognized as of diminished value. The same is especially true as to the Northwest, where your Company's output was sold through the Northwest General Electric Company, formerly known as the Northwest Thomson-Houston Company.

As you are aware, the Thomson-Houston Company had large interests in various construction and manufacturing companies, notably the above-mentioned Northwest Company, the Fort Wayne Electric Company, the Brush Electric Company, and others; the whole standing on its books at about $5,500,000. At the time of the last Annual Report, statements were obtained from the officers of such companies, and it was estimated that something less than one-half of this investment was represented by patent rights, and something over one-half by other assets. Unknown to your Board of Directors, some of these companies became unduly expanded during the Winter and Spring of 1892-3, and the stringency which began in April and culminated last Autumn, caused them to suffer greatly. Your Directors have reduced your entire holdings of Fort Wayne and Northwest stocks to a valuation of $1 each, exclusive of the amount carried in patents.

After protracted negotiations, the Northwest Company has been put in liquidation, and the territory controlled by it has reverted to your Company.

It is needless to say that the past year has been a most trying one to all corporations. It has been especially so to companies like your own, dealing with local enterprises situated in all parts of the United States, and largely dependent on normal conditions for their success and development. During the Summer of 1893, even old and strong customers were obliged to ask for leniency in paying their accounts and notes. Under these circumstances, your Company found itself with its own obligations to meet, but unable at that time to collect the money with which to meet them. The difficulties thus presented were carefully considered by your Board and were met by selling to a syndicate certain of the Company's assets consisting of claims against, and stocks and bonds of, local lighting and railway companies, the same being of a class of which your Company sold several million dollars in 1892 and which your Directors, in their last report, (pages 6 and 7), said they intended to continue to sell from time to time as heretofore "through the ordinary channels." The channels through which your Company usually made such sales having become unavailable owing to the panic, your Directors adopted a plan used on several occasions in the earlier days of the Thomson-Houston Company, and made the sale of assets above described to a syndicate which paid over $4,000,000 in cash. Although the transaction involved a large shrinkage from book valuations, the sale was at a price high under the conditions then prevailing. Few of the securities sold were listed on any exchange or commonly dealt in, and it was not possible to effect a ready sale except in bulk to a syndicate. These assets were placed in a trust known as "The Street Railway and Illuminating Properties." After the financial stringency had subsided, the right to subscribe to them was offered to the stockholders of your Company.

The depreciation in value of the assets thus sold applies equally to those still on hand. Holders of stocks and bonds of almost every kind find them quoted today much lower than a year ago, and this Company, as a holder of electrical stocks and bonds, is no exception to the rule. In fact, the shrinkage in values of electrical securities has been greater than in most others. The last year has been characterized by shrinkage in every direction, and your Company has suffered severely from it.

Since the combination of the Edison and Thomson-Houston Companies in 1892, your Directors have been earnestly endeavoring to simplify your organization. As a result of the union, your Company suddenly came into control of some twenty sub-companies, all engaged in active exploitation and having their own separate Boards of Directors and independent managements, with separate accounts and liabilities. At first your Board had little success in its efforts to centralize and simplify the organization, but the events of the last Summer emphasized the necessity of radical changes so unmistakably as to secure the co-operation necessary to effect the desired results. The "District Offices" are practically abolished, except as mere sales-offices. The business management of the Company has been concentrated at its principal office at Schenectady and its whole organization has been greatly simplified. All accounts are kept there, and all sales and credits are supervised there. So far as practicable, your manufacturing business has been and will be concentrated at Schenectady; and the operations of its other factories are now directed from there. During the short time since this change was effected, many advantages have accrued to the Company from this concentration of the selling, accounting, manufacturing and engineering departments of the Company.

Besides the shrinkage in the inventory value of the securities of local and other companies hereinbefore mentioned, as sold and on hand, there is a shrinkage in the inventory value of apparatus and material at factories and storerooms and of machinery and fixtures at storerooms amounting to $2,382,012.94. This shrinkage is partly due to the fall in value of material manufactured and in process of manufacture, and partly to the development in electrical science which has been so great during the last year or two that apparatus which at the time of the last inventory was looked upon as commercial has been superseded by entirely new and superior types. Consequently, the older apparatus has become unsalable, or of slow sale, and most of it has been reduced to "scrap" value and the remainder to much less than cost.

FINANCES.

On July 31st, 1893, the direct and indirect obligations of the Company (including the Edison, Thomson-Houston and International Companies), exclusive of the debenture bonds, were:

Direct obligations.		
Notes payable	$4,446,000	
Dividend	609,000	
Accounts payable and accrued interest	1,579,000	
Total direct obligations	$6,634,000	
Less cash on hand	1,294,000	
Net amount of direct obligations	$5,340,000	
Indirect obligations.		
Paper discounted under endorsement	$3,394,000	
Net amount of direct and indirect obligations, July 31, 1893		$8,734,000

On January 31, 1894, these matters stood as follows:

Direct obligations.		
Notes payable	$744,000	
Accounts payable, accrued interest, etc.	406,000	
Total direct obligations	$1,150,000	
Less cash on hand	591,000	
Net amount of direct obligations	$559,000	
Indirect obligations.		
Paper discounted under endorsement, guarantees, etc.	$1,425,000	
Net amount of direct and indirect obligations, January 31, 1894		$1,984,000
Reduction of debt in 6 months		$6,750,000
Of which there was received from Street Railway and Illuminating Properties		4,050,000
Reduction of debt from other sources (principally collections of notes and accounts receivable)		$2,700,000

This reduction does not disclose all the improvement of the last six months. The indirect obligations of the company, arising from its endorsement of discounted Notes Receivable, were, six months ago, almost as embarrassing as its direct debt, as the larger part of them had to be provided for by your Company at maturity, their makers being unable to take care of them. To-day no paper is under discount except such as as it is believed will be paid by the makers; consequently the indirect obligations of the Company are nominal rather than real.

At the date of this report, the direct obligations have been reduced to about $750,000.00, which are partly offset by about $400,000.00 cash on hand, and the paper under discount is reduced to about $750,000.00.

In addition to the above, there are still outstanding some important guarantees given two years ago by the Thomson-Houston Company to the United Electric Securities Company, whereby in one form and another it is claimed that the Thomson-Houston Company (and, practically, the General Electric Company) is bound to take back from the Securities Company certain bonds of Local Companies at a valuation of $702,000. This liability has been in part arranged for by the substitution of other securities, and it is not thought that such guarantees will involve any considerable cash outlay, although their ultimate adjustment may result in some loss.

Your Directors believe that the notes and accounts receivable, and such stocks, bonds, etc., as it is undesirable for the Company to hold permanently, can, with some delay and patience, be collected and marketed to such an extent as shall not only liquidate the small amount of remaining obligations, but shall also supply all necessary working capital. Earnest attention is being given to the sale of these assets.

While the liquidation of the debt has been going on, the Company has also readjusted its basis for sales, either to cash or to short credits to desirable customers. In view of the extreme depression and the uncertainty as to the early future, your Directors have not felt justified in any other course than that of adhering strictly to sales on this basis. It is believed that your Company has lost little legitimate business in consequence of its curtailment of credit to customers. It intends to confine its business to this basis, and to accept smaller profits.

Your Directors do not believe that it will be possible for some time to come to do as large a business as was done by the Company prior to the panic, although a gradual improvement has been apparent during the last two months. The street railway business, which to a considerable extent was formerly done through syndicates and promoters, many of whom have become embarassed, promises to be smaller than during the previous year. Arc lighting business is also reduced, largely because of the inability of local companies to secure capital with which to extend their business for the purpose of carrying out municipal contracts. The business of the Company, with respect to incandescent lighting, which is to a great degree performed by strong and conservatively managed local companies, is in a more healthy condition, and has not suffered so severely. The business in plants for the distribution of electrical power is promising, and many important installations are in progress. The application of electricity to various mining purposes, such as hauling, hoisting, drilling, etc., is increasing.

The future in this respect is promising. The increase in the number of local lighting and railway companies is shown by the following table:

	Feb. 1, 1892	1893	1894
Total number of local companies operating incandescent and arc lights	1158	1277	1479
Total number of railway companies	214	435	541

LICENSEE COMPANIES.

The substantial and permanent character of the business of local illuminating companies, distributing light and power by the methods, and protected by the patents, controlled by your Company, is more widely recognized year by year. The true interests of this Company lie in advancing the interests of its licensees in every possible way, and to this end prices of apparatus have been reduced during the past year, and the licensees will continue to receive from time to time, the benefit of further reductions in cost of manufacture.

PATENTS.

Substantial progress has been made during the year in the prosecution of suits against infringers of many of the more important patents belonging to the Company. The "feeder and main" patent which is of fundamental importance, particularly for low tension lighting plants, has been sustained by the Circuit Court for the District of New Jersey.

The litigation on the incandescent lamp patent has been generally successful, although the most strenuous efforts have been made by infringers to defeat the patent or devise some form of lamp that would be outside of it. In two instances we have met with reverses in this litigation which have proved to be comparatively unimportant. In these instances we are advised there is a strong probability that we shall ultimately prevail. The efforts to evade the patent by so-called "lamp-repairs," and by injecting a harmless amount of inert gas into the bulb, have been defeated.

Our Counsel are hopeful that the Courts will so construe the law that the lamp patent will run for the full term for which it was granted, in spite of the fact that the situation is somewhat complicated by foreign patents. If we succeed in maintaining this position, the patent will be of substantial value to the Company for some years.

Owing to the inevitable delays of litigation, the important cases on patents for railway work, upon which we place great reliance, have not yet come to hearing. It is expected that many of these cases will be determined during the coming year.

No final decision has been rendered against the Company on any patent. During the past year several such suits against the Company have been decided in its favor, notably the suit on the patent for the hydro-carbon treatment of the filament of incandescent lamps which has been disposed of in our favor by the decision of the United States Circuit Court of Appeals.

Upon the whole, the patent situation seems to be promising, and we believe that at the next annual meeting we shall be in a position to report substantial progress.

All expenditures for patents and patent rights during the year under review, and all expenses of patent litigation, have been charged to operating expenses.

In explanation of the items in the Balance Sheet, your Directors deem it proper to state, as follows:

MANUFACTURING PLANTS.

In the last Annual Report, pages 8 and 9, the Edison General Electric Co.'s plants at Schenectady and Harrison were carried at	$2,677,548.09
The Thomson-Houston Co.'s plant at Lynn was carried at	1,240,066.77
In addition there were sundry small machines and tools included in the report in the Lynn Factory's Inventory Account	40,913 35
Making the total manufacturing plants on January 31, 1893	$3,958,528.21

During the year the sum of $884,659.11 has been expended in additions to the manufacturing plants, and their equipment. On the other hand the sum of $902,058.84 has been written off to Profit and Loss for depreciation, leaving the cost of such plants on the books $3,941,128.98, which is $17,399.23 less than they were carried at January 31, 1893.

INVENTORY AND CONSIGNMENT.

The supplies of raw material, manufactured goods, and goods in course of manufacture, at the factories, have been carefully inventoried, item by item, and a reduction of $1.217.142.81 has been made from the sum at which they were previously carried. The supplies of finished apparatus in the different local salesrooms of the Company and on consignment have been dealt with in the same manner, and the sum of $940,365.08 has been charged off on them.

NOTES AND ACCOUNTS.

As to the Notes and Accounts Receivable (of over 6,000 customers) there is, in many instances, among those whose duty it is to pass upon their value, a wide difference of opinion. They have been classified, item by item, and your Board has taken them at the lowest suggested valuation. The amount includes $2,531,609.88 due by the Fort Wayne, North West and other allied interests.

WORK IN PROGRESS.

This represents the amount charged up against installations in progress, and is believed to be valued safely.

ORGANIZATION.

Numerous vacancies, principally due to resignations, have occurred in your official organization during the year and have been filled as indicated in the list of officers which accompanies this report. The selections to fill such vacancies have, in every instance, been made in recognition of general merit and of fitness especially displayed during the severe strain of the last eight months. During the year, the entire internal organization of your Company has been readjusted and the number of departments has been reduced. This has resulted in a large saving of expense and increased efficiency. Your Board now feels that the *personnel* of your organization is adjusted in a manner where few changes among subordinates are likely to be made in the early future, and a general appreciation of this fact will lead to more efficient work than was possible during the transition period.

C. A. COFFIN,
President.

SCHENECTADY, N. Y., April 2, 1894.

CONSOLIDATED BALANCE SHEET*—JANUARY 31, 1894.

ASSETS.

Patents and Franchises		$8,159,264.92
Manufacturing Plants		3,941,128.98
Real Estate (not including Factories):		
Edison Building, N. Y. City	$412,356.13	
Less mortgage thereon	200,000.00	
Carried forward	$212,356.13	
Brought forward	$212,356.13	
Other Real Estate	111,329.10	
		323,685.23
Stocks of Manufacturing Co.'s (Schedule A)	2,767,470.58	
Stock and Bonds of Local Co.'s (Schedules B and C)	2,723,493.17	
		5,490,963.75
Cash	591,148.88	
Notes and Accounts Receivable (Face value $14,984,697.42)	8,935,159.75	
		9,525,308.63
Inventories:		
At Factories	3,349,042.94	
At Sales Offices (including consignments)	1,485,749.68	
		4,834,792.62
Work in Progress		1,198,348 58
Profit and Loss		12,454,967.42
		$45,928,449.23

* General Electric Company, Edison Electric Light Company, Edison General Electric Company, Thomson-Houston Electric Company, and Thomson-Houston International Electric Company.

E. & O. E.—Schenectady, N. Y., April 2, 1894.

J. P. ORD, *2d Vice-President.*

LIABILITIES.

Capital Stock:		
Common	$30,459,700 00	
Preferred	4,251,900.00	
		$34,711,600.00
5% Gold Coupon Debenture Bonds		10,000,000.00
Mortgages		26,200.00
Accrued Interest on Debenture Bonds	83,333.32	
Notes Payable	744,341.31	
Accounts Payable	323,084.82	
		1,150,759.45
Sundry Credits		39,889.78
		$45,928,449.23

CONSOLIDATED STATEMENT OF PROFIT AND LOSS*—JANUARY 31, 1894.

DR.

Interest on Debenture Bonds	$499,893.62	
Dividends	1,655.150.50	
Taxes	195,457.81	
World's Fair Expenses	241 877.52	
		$2,592,378.95
Amounts now charged off:		
On Patents		733,870.75
" Notes and Accounts Receivable and on Stocks and Bonds, Sold and on hand		10,444,318 78
" Manufacturing Plants		902,058.34
" Inventories and Consignments		2,157,507.84
" Machinery, Tools, Instruments and Fixtures—Other than at Factories		224,505.10
" Sundry Losses		125,206.31
		$17,179,845.07

CR.

General Electric Co.'s Surplus, January 31, 1893	$1,024,954.56
Manufacturing and Selling Profits after Deducting General Expenses	3,189,884.37
Dividends and Interest on Stocks and Bonds Owned	433.293.06
Interest, Discount and Exchange	76,745.63
Debit Balance Carried Forward	12,454.967.42
	$17,179,845.07

* General Electric Company, Edison Electric Light Company, Edison General Electric Company, Thomson-Houston Electric Company, and Thomson-Houston International Electric Company.

E. & O. E.—Schenectady, April 2, 1894.

J. P. ORD, *2nd Vice-President.*

STOCKS OF MANUFACTURING AND OTHER CO'S.

Corporate Name.	Address.	Par Value.
Brush Electric Co. (Pref.)	Cleveland, O.	$26,300.00
" " " (Pref. Guaranteed)	"	96,500.00
" " " (Com.)	"	1,995,200.00
Canadian General Electric Co	Toronto, Can	1,250,000.00
Electric Corporation. (Subscription.)	Boston, Mass	28,200.00
E. C. Morris Safe Co. (Pref.)	"	3,600.00
Excelsior Electric Co	Brooklyn, N. Y	387,000.00
Fort Wayne Electric Co	Fort Wayne, Ind	1,921,850 00
Fort Wayne Trust Securities. (Series A.)	Boston, Mass	9,776.00
Fort Wayne-Jenney Electric Light Co	Fort Wayne, Ind	365,000.00
Northwest General Electric Co	St. Paul, Minn	549,850.00
Otis Electric Co	Yonkers, N. Y	174,000.00
Pennsylvania General Electric Co	Philadelphia, Pa	468,000.00
Schuyler Electric Co	Middletown, Conn	50,000.00
Schuyler Electric Mfg. Co. (Com.)	Hartford, Conn	84,000.00
" " " " (Pref.)	"	307,930.00
Swan Lamp Mfg. Co	Cleveland, Ohio	33,000.00
Shares of St. Ry. & Illuminating Properties	Boston, Mass	6,400.00
United Electric Securities Co. (Com.)		500,000.00
" " " " (Pref.)		23,100 00
Total (carried on the Balance Sheet at $2,767,157.58)		$8,279,706.00

In addition to the above the Company own stocks of various other manufacturing, etc., companies of a total par value of $6,037,310.00 which are carried on the Balance Sheet at a total value of $313.00.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MARCH 27 AND APRIL 3, 1894.

MARCH 27.

Accumulators :—

Secondary Battery, G. L. Ballard, Toronto, Can., 517,018. Filed April 27, 1893.

Relates to the arrangement for supporting the grids within the cell.

Apparatus for Supplying or Removing Storage Batteries, W. E Worthen, New York, 517,134. Filed Aug. 5, 1893.

Alarms and Signals :—

Electric Calling Apparatus, D. H. Rice, Dec'd., C. M. Williams, W. R. Chester and L. H. Rice, Executors, Brookline, Mass., 517,299. Filed Feb. 11, 1892.

Electrical Apparatus for Controlling Signals, M. B. Leonard, Richmond, Va., 517,419. Filed June 17, 1893.

An interlocking electrical block signal system for steam railways.

Dynamos and Motors :—

Electric Motor or Dynamo Electric Machine, J. W. Henderson, Philadelphia, Pa., 517,105. Filed Nov. 1, 1890.

Employs an armature having independent sets of coils of unequal length and independent commutators for the respective sets.

Heating :—

Electric Heater, L. Rowley, Ashland, Wis., 517,170. Filed Jan. 28, 1893.

Consists of a plurality of tubes of non-conducting material containing resistances, and means for varying the resistance of the material within the tube.

Lamps and Appurtenances :—

Incandescent Electric Lamp, R. P. Ashwell, Newark, N. J., and G. W. Tuttle, New York, 517,017. Filed Aug. 11, 1893.

Claim 1 follows :—

An incandescent electric lamp having an inclosing glass bulb and stopper, films reduced from a solution or paste of a metallic compound applied on the adjacent surfaces of said bulb and stopper, and solder or similar material uniting said films, to form an air tight joint.

Electrode for Arc Lamps, S. Heimann, New York, 517,042. Filed Sept. 15, 1893.

Consists of a mixture of powdered ashes, carbon, plumbago, asbestos and a binding substance.

Electric Lamp, F. C. Rockwell, Hartford, Conn., 517,069. Filed Nov. 6, 1893.

Claim 1 follows :—

An electric lamp receiver consisting of a transparent globe, and a base molded to fit the open mouth of the globe to which it is sealed, said base being grooved so as to render it elastic.

Measurement :—

Electrical Measuring Instrument, R. M. Hunter, Philadelphia, Pa., 517,162. Filed March 12, 1893.

Depends for its action upon an expansible conductor influenced by the current to be measured.

Electrical Indicator, A. E. Kennelly, Orange, N. J., 517,163. Filed Oct. 26, 1892.

Employs a magnet of constant strength between the poles of which is a pivoted armature controlling a pointer movable over a graduated scale.

Galvanometer, E. G. Willyoung, Philadelphia, Pa., 517,253. Filed June 23, 1893.

Miscellaneous :—

Electric Appliance for Dumb-Waiters, J. H. Roberts, Brooklyn, N. Y., 517,169. Filed Sept. 11, 1893.

Valve, J. E. Stannard, Springfield, Mass., 517,199. Filed July 24, 1893.

A steam valve operated by a piston controlled by an electromagnet.

Metal-Covered Elbow, E. T. Greenfield, New York, 517,276. Filed July 14, 1891.

Relates to the construction of interior wiring conduit.

Electrical Keyboard. C. E. Allen, Salem, Mass., 517,402. Filed Dec. 29, 1893.

A keyboard for electrical typewriting or type printing machines employing circuit closing keys having mercury contact.

Electric Elevator, F. E. Herdman, Winnetka, Ill., re-issue 11,408. Filed Dec. 29. 1891.

Relates to the arrangement of the switches and circuit connections.

Electrically Operated Elevator, F. E. Herdman, Winnetka, Ill., re-issue 11,409. Filed Dec. 29, 1891.

Employs a worm shaft, a lever moving with the shaft and having a tension device connected with it, and intermediate connection between the lever and the source of power.

Railways and Appliances :—

Electric Railway Trolley, F. S. Church, Detroit, Mich., 517,028. Filed Apl. 17, 1893.

Claim 1 follows :—

A trolley formed of two wheels having complementary grooved beveled faces.

Trolley Catcher, L. G. Mowry, Buffalo, N. Y., 517,166. Filed Dec. 11, 1893.

Electrical Railway, B. Bidwell, Philadelphia, Pa., 517,258. Filed Jan. 8, 1885.

Has for its object to place the cars in telephonic communication with the station along the line of way.

Switches and Cut-Outs :—

Electric Switch, J. S. Gibbs, Hartford, Conn., 517,100. Filed Oct. 4, 1893.

A rotary lock switch for incandescent circuits.

Safety Cut-Out for Electrical Apparatus, H. Lemp & M. J. Wightman, Hartford, Conn., 517,120. Filed July 31, 1886.

An automatic cut-out especially adapted to series incandescent lamps.

Circuit Closer, C. E. Allen, Mass., 517,401. Filed Dec. 29, 1893.

Consists of a push button and a mercury contact.

Telephones and Apparatus :—

Single Line Telephone System, J. I. Sabin & W. Hampton, San Francisco, Cal., 517,243. Filed Mch. 13, 1893.

Provides means whereby one of two connected subscribers may transmit to the operator a selective signal instead of the usual disconnecting signal.

Telephone Switch, F. R. Colvin, New York, 517,263. Filed Dec. 6, 1893.

Claim 1 follows :—

A telephone switch provided with a tilting hook or support for the telephone, the free end of the hook normally pointing upward, the angle of tilt to shift the switch to its abnormal position being sufficient to cause the hook to point downward to shed the telephone.

APRIL 3.

Accumulators :—

Process of Manufacturing Active Material for Secondary Batteries, W. A. Boese, Berlin, Germany, 517,427. Filed June 27, 1893.

The process consists in mixing a metallic oxide with a sulphonic acid of anthracene, or its analogues and simultaneously removing electrolytically soluble compounds.

Secondary Cell or Battery, G. B. Henry, Hartford, Conn., 517,455. Filed June 21, 1893.

Employs an electrolyte composed of a spongy mass of flaxseed mixed with dilute sulphuric acid.

Alarms and Signals :—

Electric Burglar Alarm, J. Frame & R. B. Morden, Cooper, Iowa, 517,450. Filed Dec. 26, 1893.

Burglar Alarm Spring, M. T. Gordon, Stapleton, N. Y., 517,547. Filed Dec. 12, 1893.

Conductors, Conduits and Insulators :—

Insulating Compound, A. Gentzsch, Vienna, Austria-Hungary, 517,452. Filed Oct. 7, 1893.

Consists of ozokerite, asphalt and amber from which the gas, vapors and oils have been removed

Insulating Tube, M. Robinson, Newton, Mass., 517,591. Filed Jan. 6, 1894.

Insulator. L. McCarthy, Boston, Mass., 517,621. Filed July 15, 1893.

Pin for Insulators, G. H. Winslow, Pittsburgh, Pa., 517,634. Filed Oct. 25, 1893.

Dynamos and Motors :—

Electric Motor, W. J. Still, Toronto, Can., 517,668. Filed Mch. 3, 1893.

Employs arc shaped magnets and armatures, each of the latter completing the arc of the former as it rotates, the polar faces of both being substantially parallel.

Electric Motor, W. J. Still, Toronto, Can., 517,669. Filed Mch. 3, 1893.

Similar to No. 517,668.

Governor for Electric Motors, J. F. Winter, Baltimore, Md., 517,714. Filed Sept. 21, 1893

Employs two sets of stationary contacts within a closed box insulated where they pass through the walls of the box and each set arranged in a part circle concentric with the shaft, and a shunt lever in the box mounted upon the shaft.

Lamps and Appurtenances :—

Incandescent Lamp, A. C. Carey, Lake Pleasant, Mass., 517,432. Filed Feb. 3, 1894.

Employs a butt of moldable non-conducting material shaped to fit any socket, having external grooves, contact pieces molded in the end and leading-in wires laid in the grooves.

Miner's Safety Lamp, J. Graham and H. Chapman, Morley, Eng., 517,520. Filed Oct. 7, 1893.

Miscellaneous :—

Electric Synchronizer for Clocks, H. S. Prentiss, Elizabeth, N. J., 517,480. Filed Nov. 3, 1892.

Electric Train Lighting and Braking System, G. W. Swartz, Florence, Ala., 517,498. Filed Sept, 1, 1893.

Employs a generator driven from the axle, and storage batteries in circuit with the generator.

Process of Filtering and Purification of Liquids, L. Wagner, J. Marr and H. Campbell, Baltimore, Md., 517 499. Filed Sept. 12, 1893.

Feeding Mechanism for Magnetic Separators, G. Conkling, Glens Falls, N. Y., 517,734. Filed June 25, 1891.

Amalgamator, N. L. Raber, Corvallis, Oregon, 517,767. Filed Apl. 8, 1893.

Railways and Appliances :—

Induction Electric Railway, C. E. Roehl, St. Joseph, Mo., 517,531. Filed May 4, 1893.

Employs a continuous iron core in the road bed and a series of primary coils located upon the core, in combination with a moving vehicle carrying a secondary core and coil in inductive relation to the primary core.

Conduit Electric Railway, W. C. Keithly, San Francisco, Cal., 517,549. Filed Sept. 17, 1892.

Relates to special designs of the trolley and the supporting device.

Conduit Electric Railway, H. A. Goreham, Decatur, Ill., 517,692. Filed Aug. 14, 1893.

Employs slotted grates on either side of the slot, covering the conduit and communicating with an outer portion of the latter.

Electrically Operated Railway Switch, W. S. Gavey, Brooklyn, N. Y., 517,748. Filed Apr. 1, 1893

A track switch actuated by an electromagnet.

Conduit Electric Railway, W. F, Jenkins, Richmond, Va., 517,804. Filed Aug. 10, 1892.

Employs brackets upon which the trolley wires rest, and an underrunning trolley.

Switches and Cut-Outs :—

Circuit Maker, J. Weaver, Canandaigua, N. Y., 517,502 Filed Sept. 30, 1893.

Electric Switch, R. Mackie, New York, 517,582. Filed Aug. 7, 1893.

Employs a contact bar moved over a series of terminals against the tension of a spring and an electrically actuated releasing device.

Electrical Switch, E. Ruebel, St. Louis, Mo., 517,664. Filed Sept. 9, 1893.

Designed especially for use with electrical cooking apparatus.

Rheostat, A. J. Shaw, Muskegon, Mich., 517,770. Filed Oct. 12, 1893.

Consists of a folded metallic band having a layer of enamel interposed between the folds.

Electric Switch, C. F. Speed, E. W. Barker and C. P. Frank, Duluth, Minn., 517,773. Filed Dec. 1, 1893.

A three point switch capable of regulating two independent circuits.

System for Controlling Electric Lights, W. F. Bradner, Denver, Colo., 517,812. Filed May 12, 1893.

Has for its special object the controlling of lamps from any number of points on an incandescent circuit.

Telephones and Apparatus :—

Microphone, W. Deckert, Vienna, Austria-Hungary, 517,564. Filed Mch. 1, 1893,

Telephone, S. D. McKelvey, Canton, Ohio, 517,762. Filed Feb. 20, 1893.

Claim 2 follows :—

In a telephone, the combination with a chair, or means of support for the body of the speaker, of a transmitter the housing of which is firmly attached to some part of said chair or other support upon and against which the body of the speaker rests, and suitable receiver.

Magneto Telephone, S. D. McKelvey, Canton, Ohio, 517,763. Filed Sept. 13, 1893.

Claim 1 follows :—

A receiver for telegraphic, telephonic, phonautographic and other apparatus, having a shell formed in two equal and similar parts which are united by a screw-cap and a handle engaged with the ends of said shell.

Magneto Telephone, S. D. McKelvey, Canton, Ohio, 517,764. Filed Dec. 6, 1893.

Employs an amplifying device to which is pivotally connected a rigid arm whose other end is provided with divergent points attached to the transmitting diaphragm in or between different nodal circles.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE HARRISON INTERNATIONAL TELEPHONE CO.

AMONG the many telephone enterprises coming into public view nowadays the Harrison company distinguishes itself by the issue of a prospectus disclosing a remarkably comprehensive plan; some elements of which are:—Capital stock $80,000,000, of which, it is said, none is for sale; an array of directors and officers comprising a considerable number of gentlemen who have been prominently before the public in a variety of capacities these many years; and the Harrison international telephone ("electric, not magnetic") together with an exchange system, "magnetic bells, lightning arresters, switchboards, both automatic and manual, generators and all other devices." The company proposes to rent, not sell, its telephones. The patents on its many devices, the prospectus says, "are all valid, having been tested in the highest Courts." Should this leave anything to be desired on the patent question it is reassuring to learn that "prominent patent attorneys have stated as their opinion that these patents are original and sound."

The directors of the Harrison International Telephone Co. are: Stephen B. Elkins, ex-Secretary of War; R. C. Kerens, of St. Louis; George R. Peck, Counsel for the Santa Fe system of railroads, of Chicago; Thos. J. Hurley, Fort Worth, Texas; C. M. Ferree, Kansas City, Mo.; Robert P. Porter, ex-Superintendent of the Census, of New York; William Warner, Kansas City; L. E. Ingalls, Chicago; H. M. Holden, banker, Kansas City; A. L. Stone, Chicago, and Dr. Harrison, the inventor of the instruments; the secretary of the company is Hon. Patrick Egan, ex-Minister to Chili. These names speak for themselves.

The above illustration shows one of the wall telephone sets of the Harrison company.

THE LODGE & SHIPLEY MACHINE TOOL CO.

"Machine Tools for the Rapid Production of Lathe Work" is the title of a well printed little pamphlet recently published by the Lodge & Shipley Machine Tool Co., of Cincinnati, Ohio, and devoted to a description of the more important of their lathes, boring, drilling, tapping, facing and milling machines and brass workers.

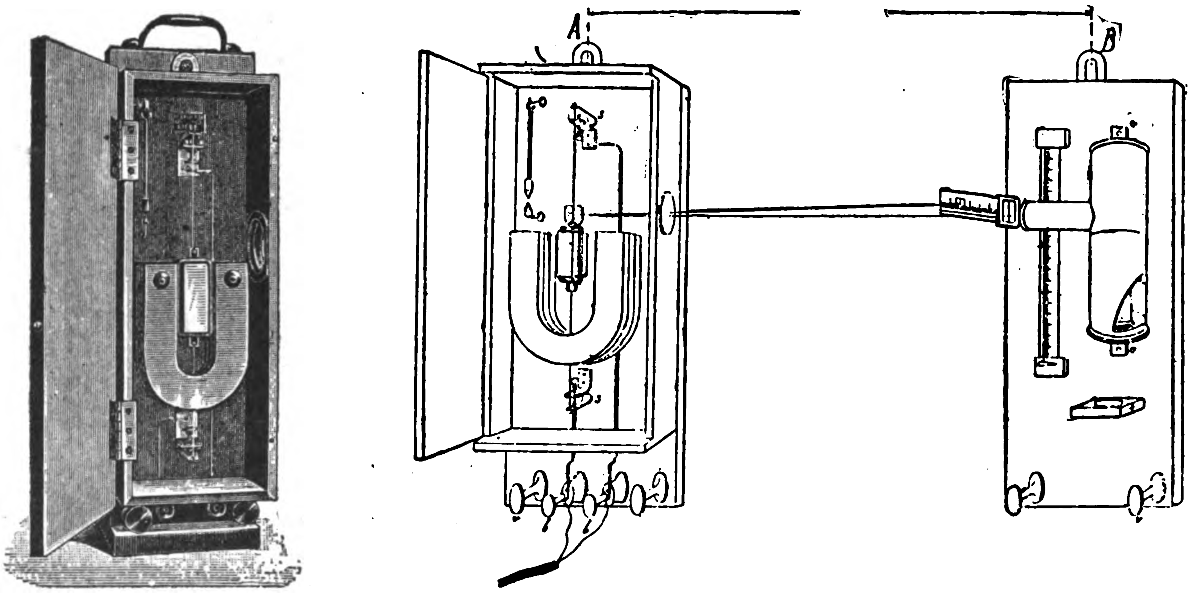
One cannot help being impressed and delighted, in glancing over its pages, with the straightforward and dignified manner in which the simple facts are set forth. The reader is not told that the apparatus described is the best in the world, or that it is superior to that of other makers. In fact, the existence of the latter is not even hinted at. Excellent illustrations are given and the text is concise and confines itself to the subject in hand.

A quantity of testimonial letters in fac simile occupy the latter pages and show far better than any high sounding claims and self-laudation could do, the excellence of the apparatus to which they refer. Modesty in trade catalogues is always refreshing and should have its reward.

THE QUEEN-LECHATELIER PYROMETER.

THE accompanying illustrations show a pyrometer modified by Queen & Co., Philadelphia, from the construction of M. LeChatelier, which is based upon the principle of measuring the electric current generated by the heating of a thermo-electric junction. It consists of a thermo-electric couple and a D'Arsonval galvanometer. The wires which compose the couple are one of pure platinum, and the other of platinum alloyed with 10 per cent. of rhodium, both of which are perfectly homogeneous. For use, the couple, which has been first connected with the galvanometer, is inserted into the furnace or oven, when immediately a current is produced and measured on the galvanometer scale, from which the temperature is readily deduced.

The pyrometer is claimed to have the following advantages: It is adapted for a very large range of temperature, *i. e.*, from 200 to 3,000 degrees Fah., but is intended more specially for high temperatures such as are met with in the manufacture of metals, chemicals, porcelain ware, etc. It is almost instantaneous in its indications, five seconds being sufficient to subject the couple to any stationary temperature; or the couple may, if desired, be left permanently in the furnace or oven, indicating at all times the temperature, and thus enabling the operator to keep an hourly record. The metals which compose the couple are not affected by gases and hence will not become oxidized or react chemically on each other at high temperatures; nor are they altered in their thermo-electric properties by rough usage or bends. The instrument is, therefore, of great accuracy and durability.



FIGS. 1 AND 2.—QUEEN-LECHATELIER PYROMETER.

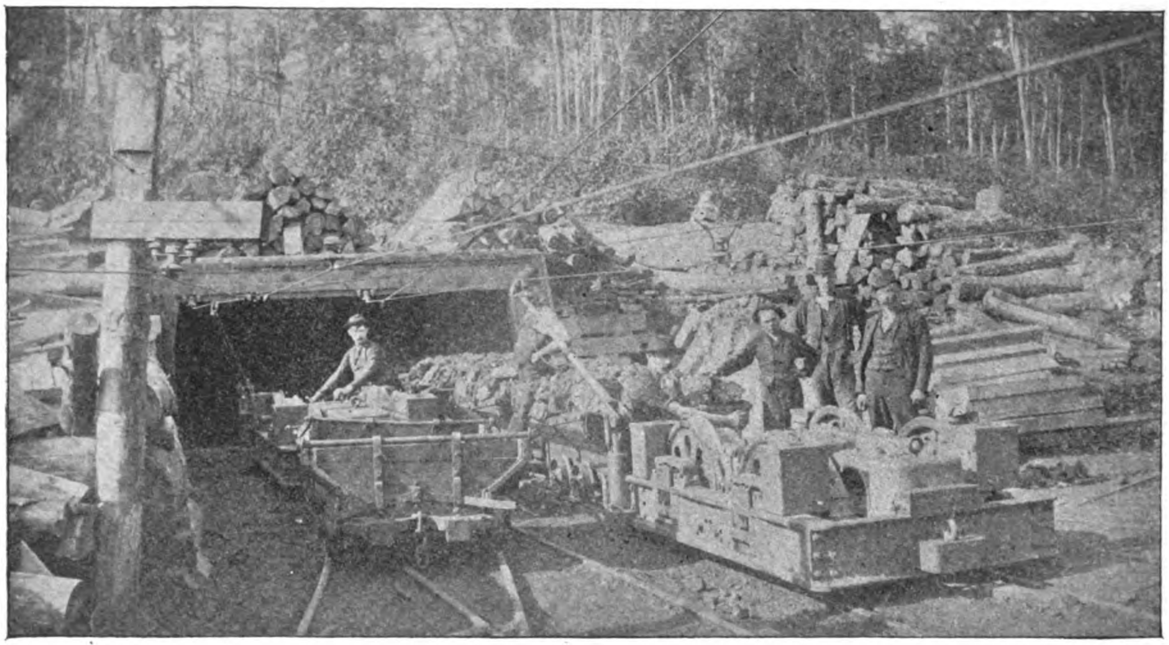
The measurement of the temperature is made by means of a D'Arsonval galvanometer, contained in two wooden boxes, which are screwed against a central wall or slab as shown in Fig. 1. Fig. 2 shows the two boxes unscrewed from the central slab and placed in their respective positions against the wall. The box A contains the galvanometer proper, and is also provided with set screws and a small plumb bob, so that it may be set vertically. Box B contains the lamp, having a lens and window with cross-hairs for throwing an image upon the galvanometer mirror in box A, which in turn reflects it back upon the scale in box B, where there are two set screws for adjusting it vertically. The two boxes are set one metre apart.

The current set up by the thermo-electric couple enters the galvanometer through the two binding posts in box A, and the deflection caused by it is shown upon the scale in box B. This scale is graduated in millimetres and it is necessary therefore that a curve be made reducing these millimetres to degrees Fahrenheit or Centigrade. This curve is very simply made from known melting points.

ELECTRIC MINE HAULAGE WITH GENERAL ELECTRIC LOCOMOTIVES.

CONCRETE examples of the adoption of electricity to the exclusion of all older methods are generally more convincing in their import to the public mind than mere hearsay or description. The accompanying illustration shows a striking example of the supersession of older haulage methods by the electric mine locomotive in a coal mine in Pennsylvania and emphasizes the vast advantage which its use confers.

The mine in question is the Bear Run mine of the Blossburg Coal Co. near Landrus, Tioga county. The locomotives, of which there are two, are of the T. M. M., that as "two motor mining" type, each of 30 horse power, manufactured by the General Electric Company. They are propelled by two W. P. 30 motors one being geared to each axle. Current is brought to the motors by a specially designed trolley arm, on which the trolley wheel is swiveled to admit of its adjustment to the various irregularities of the line wire. The trolley arm can be set in sockets on either side of the locomotive which may thus be run into headings on either side of the main haulageway which is lighted by incandescent lamps placed at the entrance to each cross-head 100 yards apart. The dimensions of the machines are: Horse power, 30; speed, 6 miles per hour; draw bar pull, 1,500 pounds; gauge, 36 inches; wheel base, 30 inches; diameter of wheels, 28 inches; width over all, 48 inches; length over all, 9 feet 6 inches; height above rail, 31 inches; weight, 7,500 pounds. The current is furnished by a General Electric D 62, 75 horse power generator driven by a Harrisburg Ideal 80 h. p. engine.



ELECTRIC HAULAGE AT THE BLOSSBURG COAL CO.'S MINE, LANDRUS, PENN.

The maximum load which these locomotives have been called upon to handle is 32 loaded mine wagons each weighing 3,200 pounds, and the run has at one part a 3 per cent. grade. The daily haul of these locomotives is about 650 tons.

The entire plant has been pronounced eminently satisfactory, the locomotives having shown capabilities beyond the specification or the General Company's guarantee. Their presence in the mine has done away with the slow-going, limited mule, and effected great economy. The small height of the machines above the rail level allows them to go into places inaccessible to any mule, and their ease of control and operation is such as to render them invaluable.

WARREN WEBSTER & CO.

Warren Webster & Co. of Camden, N. J., manufacturers of vacuum feed water heaters and purifiers and oil and steam separators, report that the number of orders they received for the above-named specialties, during the month of March, was very satisfactory and showed a marked improvement over the few former months. They say that the reason that their specialties sell during these hard times is on account of their goods being fuel saving devices. Rapid progress is being made upon the new extension of their wrought iron department, connected with the new works, which they built last year. They visit steam plants at their own expense and back their guarantees by a cash indemnity.

THE GENERAL ELECTRIC COMPANY AT THE MIDWINTER FAIR.

THE representation made by the General Electric Company at the Midwinter Fair while, of course considerably less important than that made by them at Chicago, from the point of view of mere quantity, is still the most important among the electrical exhibits which are now delighting our Western brothers by the Golden Gate. The display of its purely mechanical exhibit as made in the Palace of Mechanical Arts, and the space allotted is occupied by many of the later types of its machinery, apparatus and instruments, the major portion being devoted to a fine exhibit of electrical mining and power transmission apparatus.

The chief use of electricity on the Pacific coast is to transmit power to the cities and towns for railway and lighting work and to the mining centres for the operation of the different electrical mining apparatus such as drills, crushers, pumps, etc. The field of power transmission is very wide in the states west of the Rockies where coal is extremely costly, but where, on the other hand, there are many available water-powers which are fast being utilized.

Among other apparatus the General Electric Company exhibit the following: A three-phase rotary four-pole transformer similar in design to those now in use at Redlands, Cal., and to those which will be used at Niagara Falls. It resembles a continuous current transformer in which the primary and secondary are wound on the same armature. It is wound for a potential of 200 volts at the receiving or motor brushes while the potential of the three-phase current is 500 volts.

The most important feature is a complete three-phase power transmission plant. The generator is of 35 k. w. capacity, and is driven by means of belting by a 35 k. w. bi-polar motor. The current of the generator is led to a switchboard containing the usual set of instruments, such as Thomson-Houston indicators, recording wattmeters, switches and fuses, and the "line" is carried on oil insulators, after having been transformed in the step-up transformers from a potential of 300 to one of 6,000 volts, to the switchboard of the receiving station. Step-down transformers are there employed, which reduce the voltage to 300, under which pressure the current is delivered to a 10 h. p. three-phase motor, which is belted to what is generally termed a "drill" generator, a dynamo having rotary brushes, used to operate percussion drills. The drill exhibited is of the General Electric percussion drill type. Connection is made by means of a cable armored for its better protection in mine work.

A 10 h. p. mining locomotive, 24″ gauge, and equipped with two 500 volt iron-clad motors also forms part of the exhibit. This locomotive is well adapted for mine work as it is built very low, for entrance into low gangways. The seat for the motorman is in front, and all operations, such as starting, stopping, reversing, applying sand to the rails, etc., can be quickly done, the handles of the levers for these operations being all within easy reach. Two 16 c. p. lamps in a reflector form the headlight.

Portable mining outfits are also shown, one consisting of a special motor running a swiveled diamond drill, by means of bevel gears, which can be thrown out of mesh, so that a friction clutch admitting of the connection of the motor to a hoist can be thrown in, the motor serving for the two different operations. On the same truck with this apparatus is also mounted a 3 k. w. Edison motor, connected to a triplex Gould pump.

There are also set up and in operation a rotary pump, driven by means of a rigid coupling from a 3 k. w. Edison motor mounted on the same base, the pump delivering about 300 gallons a minute. Another portable pump outfit, consisting of a 3 k. w. Thomson-Houston motor connected by two intermediate gears (the pinions being of rawhide) to a Gould triplex pump, delivering about 100 gallons a minute, the whole being mounted on a truck. A 10 h. p. sinking pump for deep mine work, perfectly water-tight. All these pumps are working with very little noise and vibration.

A board filled, in regular style, with instruments, such as wattmeters, indicators, fuse blocks, railway supplies, etc., a few fan motors, which attempt to make things lively by means of colored ribbons attached to their frames and floating in the air currents produced; a 24″ projector, marine type; four large ball clusters on poles, containing each forty 16 c. p. lamps and two cubes of fifty-four 16 c. p. each, complete the exhibit so far as the Exposition space proper for the company is concerned.

A 200 k. w. railway generator furnishes current for cornice lighting, the lamps being connected five in series, as well as for the motor of the tower elevators. This is driven by a double piston valve engine of the Joshua Hendy Machine Works of San Francisco, cylinders 14″ x 18″, belt connected. This dynamo is on the opposite side of Machinery Hall, near the boiler house, where are also eight Thomson-Houston arc light machines, each of 50 lights. These are driven, 4 each, from two countershafts, which in turn are belted one to a Buckeye automatic cut-off slide valve engine of 200 h. p. 140 revolutions, cylinder 14″ x 24″, the speed being controlled by the isochronal regulator; the other one to a 150 h. p. Russell engine of 190 revolutions, cylinder 18″ x 20″ and fitted with the Russell automatic cut-off slide valve and fly-wheel governor.

The Annex shelters a 150 k. w. Edison dynamo, supplying current for the electric fountain and the search light on top of the electric tower. This machine is belted to a 250 h. p. tandem I. F. Thompson slide valve engine, manufactured by the Golden State and Miners' Iron Works of San Francisco. Near by is a 6,000 light alternator driven through a countershaft from a 500 h. p. Corliss engine of 80 revolutions per minute, and cylinder 22″ x 48″.

The search light on top of the electric tower is that which was exhibited at Chicago. It is a 60 inch projector with a Mangin spherical mirror, and is one of the largest in the world. The fountain is one of those which played at the World's Fair and has been fully described by us. In its new position it is much better situated for display and is not subjected to the violent competition of surrounding white buildings and blaze of light.

A HOMILY ON THE ALLEN SOLDERING STICK.

The Electric Appliance Co., of Chicago, furnish us with the following suggestive little article:

In all electrical construction a very important part of the work is making joints or electrical connections in the wire. Nearly every large electrical contractor has learned to his sorrow that a properly made joint is as essential to a perfect installation as the use of high grade material or first-class workmanship. Manufacturers of high grade wires have frequently had their insulation severely criticised and even condemned on account of the failure of some particular job to properly test up, when the difficulty has not been with the wire, but with the failure to make proper joints. Many a station manager has been perplexed in measuring up the resistance of his lines and the loss of energy thereby, to know why so many miles of line of such a size should show a resistance so far in advance of what it ought to be in accordance with the tables and other data at hand, when if the truth could be known it would be very likely discovered that quite a liberal part of the coal pile each month is being required to overcome the resistance of defective joints all along the line.

While it is not claimed that the Allen soldering stick in the interest of which this article is written is an absolute panacea for all of these ills, it is claimed most emphatically that by its use they will be very much lessened, and that in the hands of anything like a careful or intelligent workman a perfect joint is almost a certainty. Its application is so much more simple and convenient that a lineman can afford to give a little more care and attention to each joint and at the same time accomplish more work than he could under the old method.

Even in first cost the Allen soldering stick is cheaper than any other soldering flux, as a single stick which costs only a trifle is equal in the amount of work it will accomplish to something over half a pound of the most expensive soldering salts. Further than this it is well known that more soldering salts and acids are wasted than are really used—the bottle is spilled or dropped and broken or the solution is slopped over the joint and about nine parts are wasted. This waste is impossible with the Allen Soldering Stick as the stick is simply rubbed on the heated joint, all of the flux adhering to the wire. so that in addition to there being no waste there is no dripping of a destructive acid.

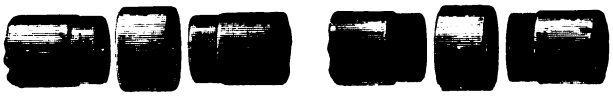
The compound is put up in the form of a round stick six inches long and one inch in diameter and has about the consistency of sealing wax when cold. When rubbed on a heated joint it melts and covers the joint, producing a bright surface to which the solder adheres with great readiness. Another very important feature and one on which too great stress cannot be laid is the fact that the Allen soldering stick contains nothing that will in any way corrode the wire or affect the surrounding insulation, which can hardly be said of any soldering salts or acids now on the market.

To sum up the points that have been covered in the foregoing, it may be said that it is cheaper than any other soldering compound; it will make a better joint electrically; it is a great time saver; it is very convenient to carry around and use; it is always ready for use; is used without danger of injury to the wire or anything near it and without waste. The Electric Appliance Company who are the exclusive manufacturers of the Allen soldering stick feel confident that they have one of the most desirable specialties that has ever been offered to the electrical trade; and the greatest improvement that has ever been made in a soldering compound, and one that is destined to displace resin, acids and soldering salts for all electrical purposes.

FIBRE CONDUIT.

The Fibre Conduit Company, of 45 Broadway, is manufacturing a conduit for underground wiring made of wood fibre, treated with an insulating and preserving compound, producing a hard and solid substance. The fibre, of the best quality, is made into tubes on a machine designed for the purpose by Prof. Henry Fairbanks and Mr. Howard Parker, of St. Johnsbury, Vt., the product and machines being protected by numerous patents. The tubes are completely saturated with a treating mixture which has been prepared under the direction of eminent chemists. The finished pipe is in five-foot lengths, and is uniform in thickness, with smooth surfaces.

The company furnish pipe in standard sizes from 1 inch to 2 feet in diameter together with regulation fittings, section boxes, etc., and make two standard joints; one a socket joint, and the other a screw joint, as shown in the accompanying illustrations. They also make, when desired, a special socket joint wholly in the pipe, which does not increase its outside diameter.



Fibre Conduit Joints.

As an underground electrical conduit it is claimed to make a strong and perfectly tight duct which can be readily opened at any point to tap the cables; it can be easily put together, and, when laid underground, is much more durable than iron, being unaffected by either acids or alkalies. It is also claimed not to contract or expand, or to be injured by heat or cold, and is a perfect insulator, a conduit seven-sixteenths of an inch thick having been tested on a twenty thousand volt alternating current without any perceptible effect. It is considerably cheaper than iron, and, being only one-fourth its weight, the cost of transportation and handling is comparatively small. Moisture does not condense on the surface as in metal pipes, and no injurious or disagreeable effect is produced on water passing through it. It will stand exposure to a temperature of 200 degrees Fahr. without weakening, and will carry liquids at 150 degrees Fahr. at considerable velocity without injury. It is easily cut with ordinary tools, and joints, fittings, etc., can be introduced at any point. The joints are strong and tight.

On May 1 the company will remove to new offices in the Home Life Insurance Building, 257 Broadway.

THE BUCKEYE ENGINE CO.

Mr. H. T. Porter, the New York sales agent for the Buckeye Engine Co. has issued the following notice to the trade:

We beg to inform you that on April 1st, we will remove our office from 18 Cortlandt street to 39 & 41 Cortlandt street. We will have larger and more commodious offices, where we will be pleased to see our patrons and friends at all times, and give any information or estimates they may desire.

In addition to our regular line of plain, tandem compound, cross compound, and triple expansion horizontal engines, we wish to call your attention to our new vertical compound engines for electric light and railway service, ranging from 150 h. p. to 1,200 h. p. and over. This engine is specially adapted for direct connecting to dynamos, and we guarantee it to work as economically as any compound engine on the market, and to run with superior regulation.

THE UNITED ELECTRIC IMPROVEMENT CO.

The United Electric Improvement Co., Drexel Building, Philadelphia, manufacturers of complete central station equipments, are advertising extensively with a view to attracting the notice of responsible electrical concerns who are actively engaged in the sale of electric lighting apparatus. It is their intention to arrange with such responsible companies for the sale of their new type of alternator, which they have operated under practical conditions a sufficient length of time now to demonstrate to their own satisfaction its superiority. They have now reached the point where they are determined to push the sale of this apparatus, and are desirous of coming in contact with the best engineers of the country through whom to work.

REMOVAL OF VALLEE BROS. & CO.

Messrs. Vallee Bros. & Co., now at 17 North Sixth street, Philadelphia, will remove to 617 & 619 Arch street, about April 15th. They will have in their new quarters two large floors each 30 x 160 feet, which will give them increased facilities to handle their large and rapidly growing business. It is their intention to deal in electric railway, telephone and telegraph supplies as well as their well known electric light supplies, which will also be largely increased in number.

The business of this firm has grown to such large proportions in the past two years as to render their present establishment totally inadequate to handle their business with proper convenience, and they have been consequently forced to seek larger quarters. They have arranged to issue a catalogue of the various supplies they are selling, which will be mailed to their customers as soon as completed.

IMPORTANT ELECTRIC RAILWAY WORK AT PROVIDENCE, R. I.

Previous to the first of August, 1893, the Union R. R. Co., of Providence, R. I., had in operation but 12 or 15 miles of electric railway. It now has an extensive system of nearly 100 miles in operation, covering not only the entire city of Providence but much of the available territory round about it. The work of construction under contract was begun about the first of July last by the Woodbridge & Turner Engineering Co., of New York, and during the summer and autumn over 75 miles of overhead line work was completed ready for operation. About half of the line is constructed with iron poles, mainly of the lattice type though a considerable number of Walworth poles have also been used. On the remainder of the line, both span and bracket construction, Georgia pine poles are used throughout. The line construction embodies all the latest and best features in this class of work, the line equipment being furnished in part by A. & J. M. Anderson and in part by the General Electric Co. by whom the entire motor and generating equipment was supplied. The feeder lines are run on the poles, there being over 80 miles of feeder wire on the whole system, mostly 500,000 C. M.

The lines radiate in all directions from the central business section of the city reaching to the towns of Riverside, Rumford, Pawtucket, Centerdale, Auburn, Cranston, Olneyville and Lakewood. The work of construction was entirely in the hands of Mr. Elmer Bell, the superintendent for the Woodbridge & Turner Co., and was pushed vigorously through to completion so that the whole system was practically ready for operation by the middle of November.

The Woodbridge & Turner Co. are to be congratulated on this addition to their long list of successful contracts, in the electric railway field. They regard present conditions as quiet but very hopeful.

NEW ENGLAND NOTES.

Hathaway and New England Buildings.—The advent of several important electrical and engineering concerns who are establishing branch offices in Boston impels us to call attention to the Hathaway and New England Buildings situated on Atlantic avenue at the foot of Summer st. next the N. Y. & N. E. R R. Co. where these interests are centered and where many of these concerns are locating. Although the General Electric Co. have moved a number of their departments to Schenectady they still occupy several floors of these buildings and are likely to for an indefinite period. The rentals are reasonable and the comforts and conveniences and superior light are a great attraction. Most all of the rooms face the south, having the sun in winter and the southwest breezes during the summer and the views overlooking the city are very fine. There are fast running elevators, electric lights, mailing station, public telephone, lunch club on the upper floors and an open restaurant in the basement for the benefit of the tenants and their employés. It is a little world in itself and the two buildings are larger than any other, except the Exchange Building, in Boston.

Almon & Sargent, is the name of a new company with headquarters at 620 Atlantic avenue, Boston, and 136 Liberty street, New York, which has been formed for the purpose of general electrical contracting as well as the furnishing of supplies. Mr. George H. Almon, is well known in New England, having been connected with the Thomson-Houston Electric Co., for eight years and later with the General Electric Co., with which companies he held the position of superintendent of construction of isolated plants and central stations. Mr. Sargent has also had about five years' experience with the Thomson-Houston Co., and is also well known to the trade. Associated with them also is Mr. L. J. Wing, who has been with the T.-H. Co. and General Electric Co. for about 10 years, and has the reputation of having sold every central station in the State of Vermont, besides many others in other states. Mr. Sargent will give his whole time to the Boston office, but Mr. Almon will divide his time between New York and Boston. The New York office is in charge of Mr. L. O. Brewster, who has wide experience in the electrical business, and is well known in this city. Almon & Sargent will act as agents for the well known dynamos and motors of the Belknap Motor Co., of Portland, Me., and will also be general agents for the L. P. & D. Transmitter Co., of Montpelier, Vt., manufacturers of the L. P. & D. system of transmitting power from engines or shafting to dynamos. The company has already a large amount of work on hand, and with such an amount of talent, should command instant success.

WESTERN NOTES.

Mr. Geo. S. Rosenthal, of the St. Louis office of the General Electric Co. was in Chicago last week.

The Chas. E. Gregory Co., Chicago, are not complaining of any lack of business, Mr. Gregory having sold nine dynamos in a single day last month.

The Chicago Heights Water, Light and Power Co. has been incorporated with a capital stock of $100,000 by Henry L. Wallace, Homer Abbott and M. H. Kilgallon.

Mr. H. C. Whitney, Manager of the Motor Department of the terior Conduit and Insulation Co. of New York, is on his way home from a very successful business trip through the West.

Mr. J. W. Godfrey, the General Manager of the New York Insulated Wire Co. stopped in Chicago for a few days last week, being on his way home from a very successful trip to California.

The LaGrange Automatic Telephone Co., was incorporated at LaGrange, Ill., last week with a capital stock of $40,000. The incorporators are F. C. Elder, Edw. F. Comstock and J. R. Foss.

Rowell & Chase Co., Kansas City, Mo., have made arrangements for handling a complete line of the products of the Sioux City Engine and Iron Works, of Sioux City, Iowa. They will also act as agents for the Watertown Engine Co., Medart Patent Pulley Co., Snow Steam Pump Works, and several other first-class houses.

NEW YORK NOTES.

Neftel, O'Connor & Co., Inc., have secured the contract for the 135th street line of the Union Railway Co. and also the entire construction of the Mt. Vernon lines of the same company.

H. B. Coho & Co., 203 Broadway, agents for Mather and Waddel-Entz apparatus, announce special bargains on old stock, including switches, ammeters, etc. They are making a "drive" in small plants for country residences, and have prepared a schedule of prices on gas engines, dynamos and batteries.

PHILADELPHIA NOTES.

Messrs. C. H. & H. Stanton have the contract to install a 500 light plant in the steamer "New York" which runs from Philadelphia to the Fishing Banks. Specifications were drawn up by Mr. John McLeer, electrician, under whose supervision the work will be done. The plant promises to be the model steamer plant on the Delaware.

Messrs. Pepper & Register, Provident Building, Chestnut and Fourth streets, Philadelphia, have secured the contract for the complete track bonding of the road of the Electric Traction Company of Philadelphia. The bond which will be adopted on this work is that manufactured by the Technic Electrical Works of Philadelphia. They are also now building the overhead lines of this company's road.

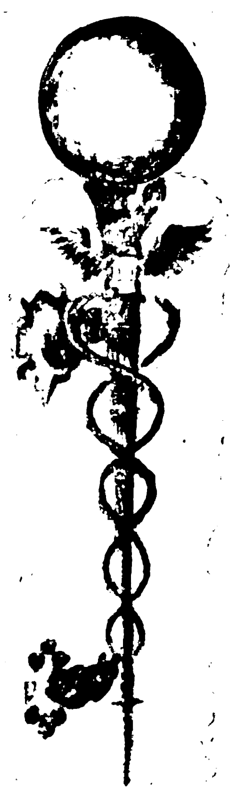
☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVII. APRIL 18, 1894. No. 311.

THE NEW HEADQUARTERS OF THE POSTAL TELEGRAPH-CABLE COMPANY, NEW YORK CITY.

I.—INTRODUCTORY.



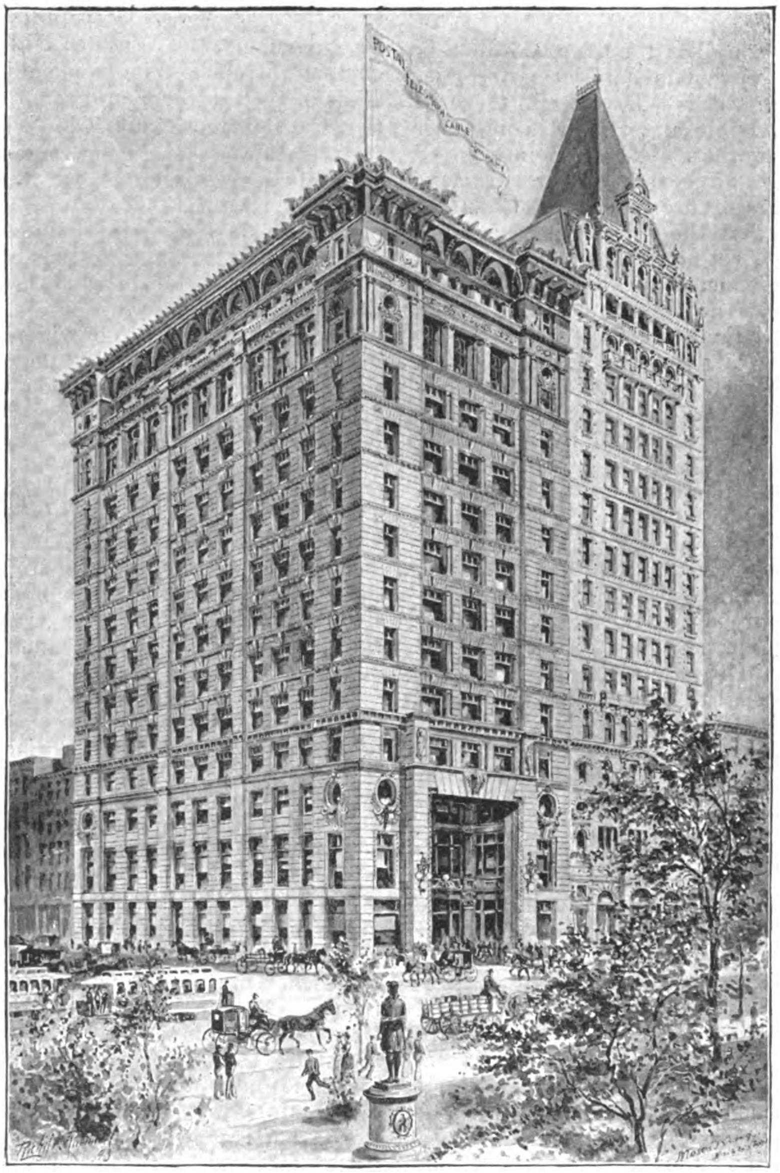
So LONG as the telegraph in this country remains a private enterprise, so long, it is believed, will there be telegraphic competition in one form or another. The arguments of many advocates of government telegraphs are based on the assumption that the telegraph is a monopoly, yet never has there been an hour when some kind of competition was not seen in this field; while to-day the conditions are such that they guarantee the public the high degree of promptitude and efficiency always due to an eager bidding for its favors by rival companies. The form of this modern competition becomes the more striking if we consider the antecedent relations and struggles culminating in the financial panic of 1884, from which, as after a great convulsion of nature, the new era begins. The earlier consolidations in the domain of practical telegraphy, say to 1866, had been largely necessary, in fact, inevitable, but the enormous increases of capitalization due to the immediately improved prospects for business enjoyed by a company reaching everywhere, without let or hindrance, soon called new opposition into birth; and thus the Western Union Telegraph Co., an aggregation created rather by commercial evolution than by the men controlling it, had to fight or absorb other companies brought into existence simply as a basis of speculation or merely to be sold out. It might be supposed that such conditions were helpful to the technical art of telegraphy, but in reality they were of little use in that respect, for one cannot point to-day to a single valuable survival of any of the ingenious plans and schemes of quick, cheap telegraphy then heralded to the world as the great desideratum.

As we have intimated, the beginning of the year 1884 found the Western Union Telegraph Co., in spite of its latest successive acquisitions of the Atlantic and Pacific, American Union, and Mutual Union, beset again by a literal swarm of competitors, including the Baltimore and Ohio, Bankers' and Merchants', Postal Telegraph, American Rapid, Southern, and half a dozen others of smaller calibre. Between them all a more or less close bond of union and mutual understanding existed, and the bulk of their traffic was large. Just how they would have settled down together had the piping times of prosperity continued, can only be conjectured; but it is a matter of record and history that the end of 1884, a year of crash and disaster in Wall street, saw them all practically wrecked, except the Baltimore and Ohio, which by reason of the financial support of the great railway company which built it still kept the seas only to be captured and taken into port by its old enemy, the Western Union, as soon as the railway company itself became financially embarrassed. When the crisis of just a decade ago came, therefore, people assumed that the Baltimore and Ohio would be the rallying point for telegraphic opposition, and for two or three years it certainly served the purpose of maintaining the competition which we have characterized as a permanent element; but the absorption of this company by its formidable rival in 1887, blighted hopes in that quarter and provoked a general, shallow pessimism as to the possibility of any competition at all thereafter.

The situation was, to outsiders, apparently a gloomy one, but the darkest hour of hopeless wreck and confusion had seen the first quiet steps taken toward the reconstruction of a system which to-day may fairly be spoken of as offering the cleanest, strongest and best competition ever witnessed in the telegraphic field. It happened in the earlier days of the Postal Telegraph Co., that Mr. John W. Mackay, on the inducement of some old Californian friends, had taken up a block of what afterwards proved to be its "in-securities" and even shown some interest in its management. Mr. Mackay had a strong leaning towards investments aiming to benefit the public and increase commercial facilities, and it was not long before he gave another proof of his interest in such work by becoming a heavy backer of the Commercial Cable enterprise. Things looked extremely well, and the laying of the new cables proved highly successful, but the commercial collapse of 1884 left Mr. Mackay with a mass of land telegraph property on his hands in a state of shreds and chaos. In this emergency he turned to Mr. Albert B. Chandler, of whose experience in the business of telegraphy and conservative judgment as a manager of affairs he had learned from several sources. After the telegraph consolidation of 1881, Mr. Chandler foresaw the great future of the new business of electric lighting and accepted the presidency of the Fuller Electrical Co., owning the fundamental Gramme dynamo patents in this country. Mr. Chandler continued actively engaged in the lighting field for more than two years. But telegraphy was his first love, and on being invited by Mr. Mackay to return to his old pursuits, under conditions that were agreeable save as to the warlike attitude and tangled relations of the companies engaged in telegraphy, Mr. Chandler consented to undertake a task which to ninety-nine men out of a hundred appeared quite hopeless. The selection was indeed a happy one, for Mr. Chandler had had an exhaustive experience, and had gone through the successive stages of the craft, from that of operator and manager in Western Union service before the war, and of cipher telegrapher in the War Department during the war, to that of president of the Atlantic & Pacific Telegraph Company. He knew something, too, of uphill fight as a manager; and in dealing now with lines called by others "United" because that was the one quality they lacked, needed all his energy, courage, discretion and skill.

But the amelioration hoped for so earnestly soon began. The welter of debt, wreck and confusion disappeared, and Mr. Chandler was able by steady degrees of advance to show chiefly by new and substantial construction a network of land lines and a volume of business that not many months before had seemed utterly impossible. Meantime the allied Commercial Cable interests, diligently fostered by Mr. George G. Ward, general manager, had grown enormously in importance and magnitude, and the time soon arrived for a concentration in one building, especially adapted for the service, of the various executive and managerial departments, in closest touch with the Postal receiving and operating department. It must be remembered that the Postal system, once so slim and trivial, now ramifies throughout the country. Every day sees an addition to the 3,500 offices it reaches. Everyday witnesses the activity of its construction gangs, so that the figures here set down of 35,000 miles of solid pole line and 145,000 miles of well strung wire over which Postal messages go will be far short of the mark even before they get into type. The call for an adequate headquarters was imperative, and obviously could be no longer delayed.

Parenthetically it may be pointed out that this steady, persistent development is natural and healthy. It is not the result of rate cutting but is based on normal conditions. The low morality of a competition which proposes to ruin a rival by doing business at unremunerative rates, only to increase them unduly at the public expense when the rival is haply removed, has never commended itself to Mr. Chandler; and he has behind him a growing public sentiment against such practices. When the Postal system, with the other disjecta membra of bygone organizations fell into his hands, its rates were low, and money was being lost. As a prudent and conservative manager, to whom any idea of continuing such unbusinesslike methods were wholly abhorrent, Mr. Chandler took at once the first step toward fair rates, and it is perhaps worth recording that the initial compact, which has broadly run to this day, was effected by him with Mr. Jay Gould himself. There have been at least three results; the continued stability of the Western Union as a property; the assurance to the public that efficiency would be the sole basis of appeal, by both parties, for its patronage; and the erection of the new Postal Telegraph building as a substantial concrete illustration of the prosperity to be won by a sound, honest policy.



New Building of The Postal Telegraph-Cable Co., Broadway and Murray St., New York.

II.—THE NEW BUILDING.

It need not surprise us that so substantial and stately a building as the new Postal had its inception three years ago, when the influx of business and the increase of staff compelled Mr. Mackay and Mr. Chandler to take some thought of a more than temporary provision for the future. There are many conditions to be considered in the location and construction of a central telegraphic headquarters, and their variance or dissonance might lead one to make costly mistakes. The location of the Western Union building at 195 Broadway is excellent, but as a telegraphic headquarters it always rested under the condemnation of experts, until the fire a few years ago gave the management a chance to make it really useful at the expense of its looks. It may not be generally known that one of the schemes prior to the time when Mr. Orton gave Broadway one of its first huge structures was to take the old Astor House hotel, and convert it into telegraphic headquarters. That interesting project fell through, but Mr. Chandler has succeeded in securing from the Trinity Corporation, an even better site, on the corner of Murray street, facing City Hall Park and Printing House Square, looking southward across Broadway to the General Post Office. In a sense it may be said to mark the northern limit of the New York electrical district. Curiously enough, the immediate vicinity is that in which Mr. Mackay spent his boyhood, little dreaming that on this ground he was in mature life to put up a noble building that would accommodate more people than the whole street in which he then lived.

No sooner had terms been made as to the site than a Building Committee composed of Messrs. Chandler, Baker, Ward and Platt was formed. Messrs. Harding & Gooch, of New York City, were selected as architects; and the work was begun. Our illustration gives an admirable idea of the appearance of the building and of its surroundings. It fronts over 70 feet on Broadway, with a depth on Murray street of 156 feet, and an L at the rear, 30 by 50 feet. It rises 14 stories from the street level, the walls to the fourth story being of a rich Indiana limestone and the upper stories of soft gray brick trimmed with terra cotta, all of a color that will wear well in the clear New York air. The frame of the building is, of course, the best structural steel. A notable feature is the largeness of the windows, which frame, as though they enclosed pictures, beautiful views in almost every direction, thanks to the location of the building. The interior finish in hard woods is excellent, and is matched by the best quality of plumbing, tiling, etc.

Starting at the sub-basement of this massive building, we find there the engine and boiler rooms, the pump room, coal vaults, the dynamo room, the motor-generator room, etc. Each of these important departments will be described in detail, later, when it will be seen that the Postal Building is the latest and finest exemplification of a very wide range of the modern electrical arts. Above the sub-basement, itself 12 feet high, is a lofty basement which is to serve the Postal Telegraph Co. as supply and storage department, linemen's and messengers' rooms, and is therefore equipped with every facility for the disposal and distribution of supplies.

The first floor at the street level is a magnificent receiving and delivery department for the company's local traffic. It is lined with rich yellow Sienna marble, trimmed and finished with solid brass mountings, rails, etc., and paved with mosaic. The public gains access to this chamber, from the outside, through a lofty alcoved entrance, above whose entablature are two graceful figures expressive of the character of the building; while on each side of the wide portal are mounted huge ornamental flambeaux, each sixteen feet long, surmounted by a Commercial Cable globe masking a cluster of incandescent lamps. The effect is quite grandiose and impressive.

From the second up to the tenth floor, inclusive, the space will be occupied by private firms, etc., and the offices already taken house a good many electrical concerns, such as the Sprague Electric Elevator Co., Walker Mfg. Co., Dr. C. T. Hutchinson, P. Lemaire, W. J. Johnston Co., Ltd., etc. The eleventh floor the Postal Company has reserved for its own executive offices and accounting departments, in the rear half, while the front half has been taken by the Commercial Cable Co.; Mr. Mackay having a private office midway between the two. This is practically an executive floor, and it is most conveniently arranged for the swift transaction of business. Above it comes the general operating department which occupies a superb, high pitched hall, Fig. 1, that covers the entire twelfth floor. It has light from four sides, and its windows are very large, the ceiling being 18 foot pitch. The thirteenth floor provides room for the miscellaneous staff, and is also cut up into coat rooms, lavatories, etc., arranged with a keen eye to the ease and comfort of the employés. The fourteenth floor has been eagerly preëmpted by the Hardware Club as a home for its members, who are very thick in this neighborhood, and who can reach their cosy parlors by six rapid electric elevators.

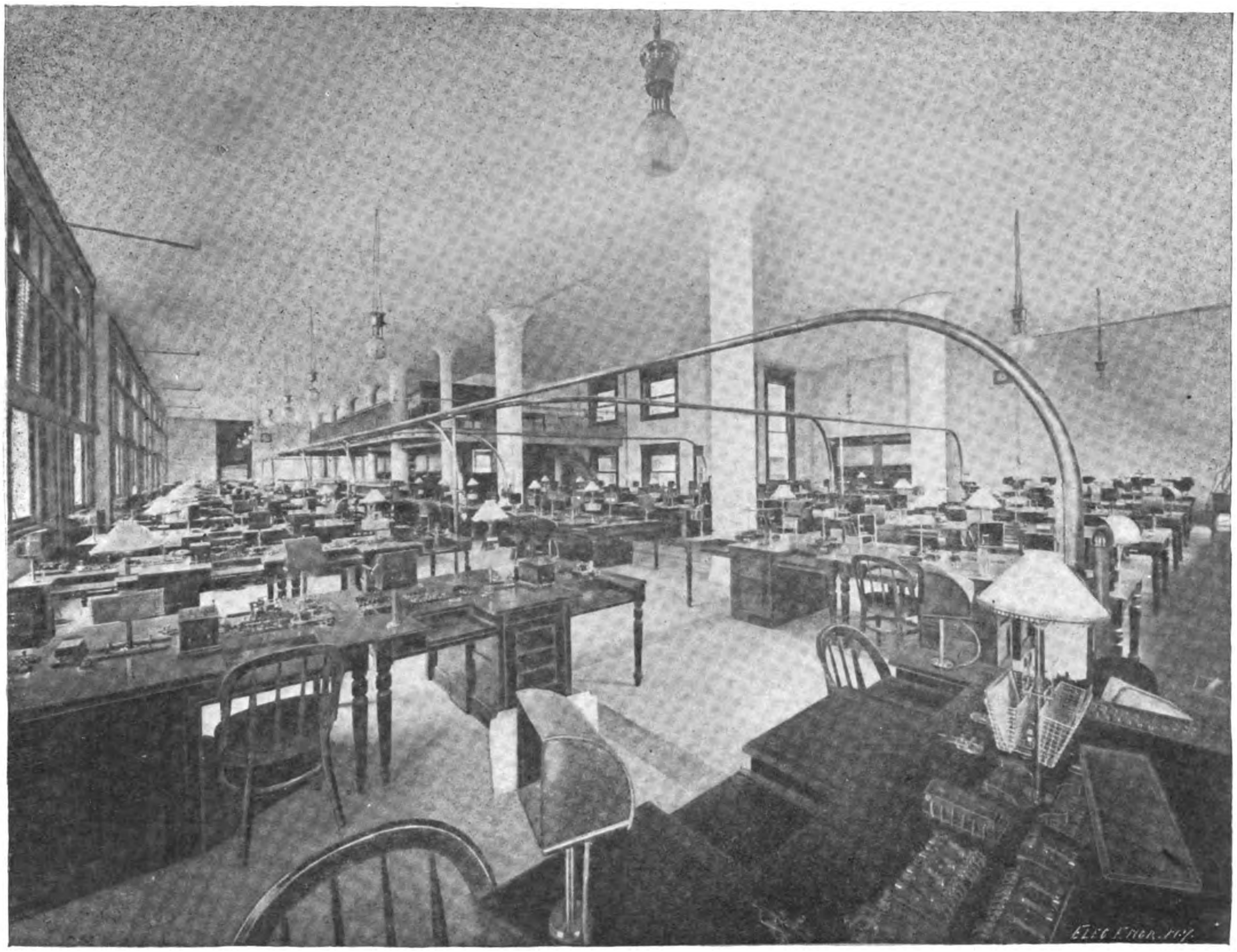


FIG. 1.—MAIN OPERATING ROOM ON THE 12TH FLOOR, POSTAL TELEGRAPH BUILDING.

This brief statement will give a broad idea of the building and its general arrangement, but we hasten on to discuss a number of the interesting and novel features which make the new Postal so striking an exhibition of all that is most modern and successful in electrical engineering development. The officers of the Company have in this respect shown the utmost courage and liberality, and have their reward in a plant that challenges admiration at every turn. It is a happy coincidence that sees the jubilee of the sending of the first telegraph message in America signalized by the opening of such a beautiful and perfect palace of telegraphy, in which the very latest and newest ideas have been pressed into employ for the promotion of speed, efficiency and satisfactory service.

III.—THE DYNAMOTOR TELEGRAPH PLANT.

Occupying a corner in the sub-basement of the building and covering a space barely 10 by 20 feet, is the current generating plant required for the entire telegraph system concentrated in the new building, Fig. 2.

With the opportunities here offered, the employment of batteries was from the very beginning left entirely out of consideration and the question merely resolved itself into devising the most simple and reliable system of current generation for telegraphic purposes. As a result of a thorough study by Mr. Francis W. Jones, chief electrician of the company, of the conditions, it was resolved to employ motor generators or dynamotors, in preference to machines driven by belting from shafts. By employing dynamotors each machine is entirely independent of every other and, as we shall see presently, the number of relay machines required is only one-half that which would be necessary, where all the machines are dependent upon a single outside source of power. The selection was also made possible by the fact that two main independent sources of current supply were available, namely that of the building itself and that of the Edison Electric Illuminating Co., whose circuits have been connected to the building, and, in fact, have been wholly depended upon until the completion of the building's steam plant.

The machines, sixteen in number, built specially by the Crocker-Wheeler Electric Co., are mounted on two piers of buff brick and fastened to heavy pine planks; all connections and leads run straight down the centre of the piers in Interior Conduit tubes so that no wires are visible. The number and voltage of the machines are as follows:

One	40	volts	+	One	200	volts	—	
"	85	"	+	"	350	"	+	
"	"	"	—	"	"	"	—	
"	130	"	+	Three	50	"	}	Intermediate
"	"	"	—	"	100	"	}	Machines.
"	200	"	+					

In addition there are five spare motor-dynamos that can be substituted for either of the + or — of the above machines of equal voltage, viz.: One 40 volts +; one 85 volts + or —; one 130 volts + or —; one 200 volts + or —; and one 350 volts + or —. The 40 volt machine is employed exclusively for the local work, such as sounders, etc., and the other machines give all the range and flexibility required for the system.

The maximum output of all these machines is 11,950 watts and they are calculated to replace 47,725 cells of Callaud battery. Aside from the enormous saving in space as well as in economy of operation, the low resistance of the dynamo generators, as compared with that of the cells, materially improves the service, especially in wet weather, when "cross fire" has in the past created much annoyance on continuous lines. This will be obvious when we consider that with two or three lines connected to a single battery of high resistance, part of the current coming in on one line is apt to branch off into another line connected to the same battery. With the dynamo offering but a few ohms resistance, even at the highest potential employed, the resistance to ground is practically nil as

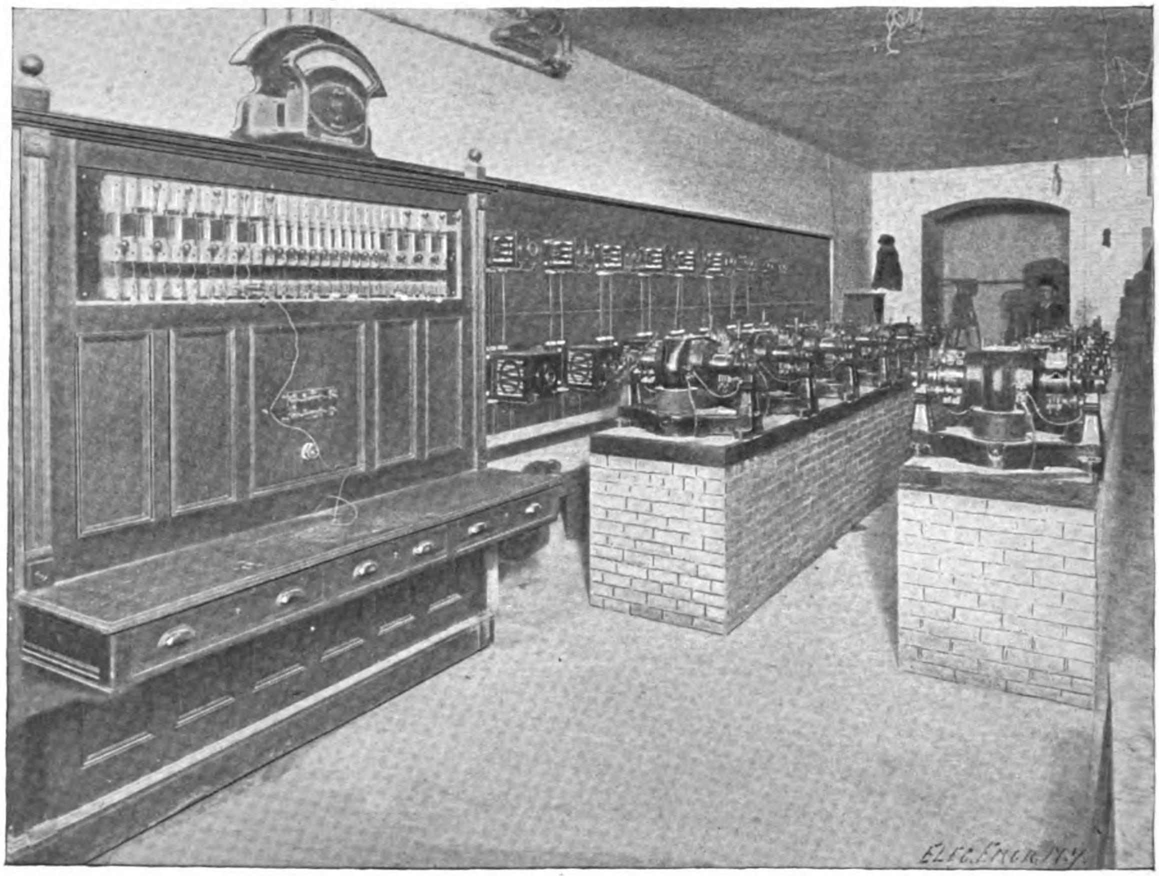


FIG. 2.—THE POSTAL TELEGRAPH DYNAMOTOR PLANT AND DYNAMO TELEGRAPH BOARD.

compared with that of the line, and hence any number of wires might, in practice, be connected to the same current source without causing disturbance from "cross fire," due to the cause mentioned. Fig. 3 shows the dynamotor in perspective.

Besides being very finely finished, and made to comply in every detail with the particular requirements of the Postal company, these machines have some special features. They are provided with regulators having 43 contacts giving 40 steps of regulation, each carefully calculated and arranged in a logarithmic proportion, so that with *any* load on machines from lightest to full load, the effect of turning the regulator one step, whether near the "full on," or the "full off" position, changes the E. M. F. of the machine the same percentage. That is, the action of the regulators is absolutely uniform in all positions and at all loads, and their capacities are such as to reduce the E. M. F. 25 per cent. below the maximum, even when the machine is running empty. No margin is allowed for raising the voltage above normal, but the machines are all built for normal voltage a little in excess of that required. Every machine is severely tested for the very highest insulation. The oiling arrangements and the position of machines are such that they will run a month at a time with absolutely no attention of any kind, and will run a year or more with no attention but renewal of oil.

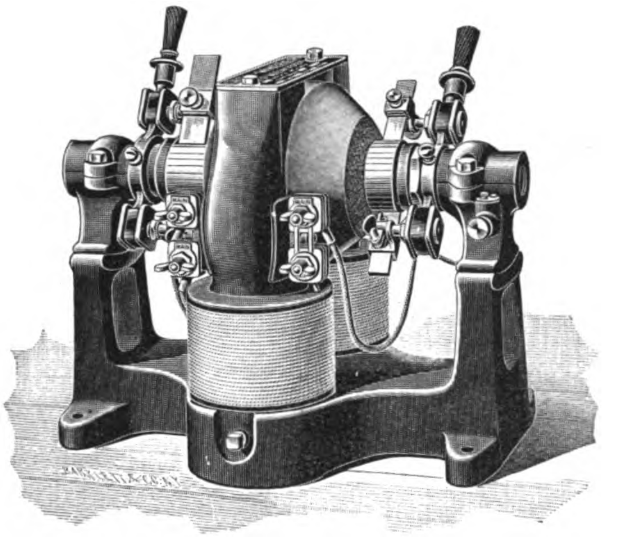


FIG. 3.—CROCKER-WHEELER TELEGRAPH DYNAMOTOR.

IV.—THE TELEGRAPH DYNAMO BOARD.

Situated close to the dynamos is the telegraph dynamo board which forms the connecting link between the machines and the operating room on the 12th floor of the building. It is to this board, Fig. 2, that the leads, from the machines are carried and connected to contact-plates controlled by switches which close the circuits to the operating room. The functions of this switchboard will be readily understood from an inspection of the diagram, Fig. 4, which also shows the connections of the machines to the main switchboard.

For simplicity's sake, we have shown the machines of but one potential connected to the board, namely that of 350 volts. Two of these machines, A and B, are always in regular operation, furnishing the plus and minus potential, with a third as a relay, which can be thrown in to replace one of the others when necessary, as will be shown presently. From the — brush of machine A the circuit goes first through a fuse and then into a contact plate of the knife switch K¹; the + potential of machine B goes to a similar switch on the other side, K¹. Alongside of each of these switches is another, K², K², from which connections lead to the relay machine C, while the other side is joined to the same wire as K¹, leading to the operating room. The wires from the switches K², K², run to the main switchboard and connect to a reversing switch R S.

It will now be seen that when the switch is thrown upward the + potential of the relay machine C, is led to the the switch K² at the 350 + potential side of the board, and the other terminal of the machine is put to earth; but when the switch is thrown over to the other side the — potential is carried to the switch of K² connecting with the — 350 volts potential on the board. Normally, of course, the reversing switch is open. It will thus be seen that by merely throwing the reversing switch, R S, the single relay machine can be connected either to the plus or the minus side of the circuit, and its substitution for a running machine is effected without the slightest discontinuity of the working current.

The switches S¹ S² S³ which are mounted on the main switchboard controlling the power and lighting circuits of the building, control the motor side of the dynamotors through the starting boxes.

All switches on the dynamo board are drilled for the insertion of plugs. Mounted on the board is one of the Weston illuminated dial voltmeters, reading up to 500 volts; by inserting plugs in the drilled contact plates, above referred to, their potential can be read off on the voltmeter and in this way the working of the machines can be checked at all times; at the same time, its use is essential, in order to bring a machine up to proper potential before throwing it into a working circuit. By inserting another set of plugs the strength of the current can also be measured by an ammeter. The board is also provided with a reversing switch in circuit with the voltmeter which is necessary, since both plus and minus potentials are employed, whereas the voltmeter is only arranged to read for currents in one direction. The board is made of marbleized slate and all wires pass through rubber bushings to secure the best possible insulation. At the back of the board are

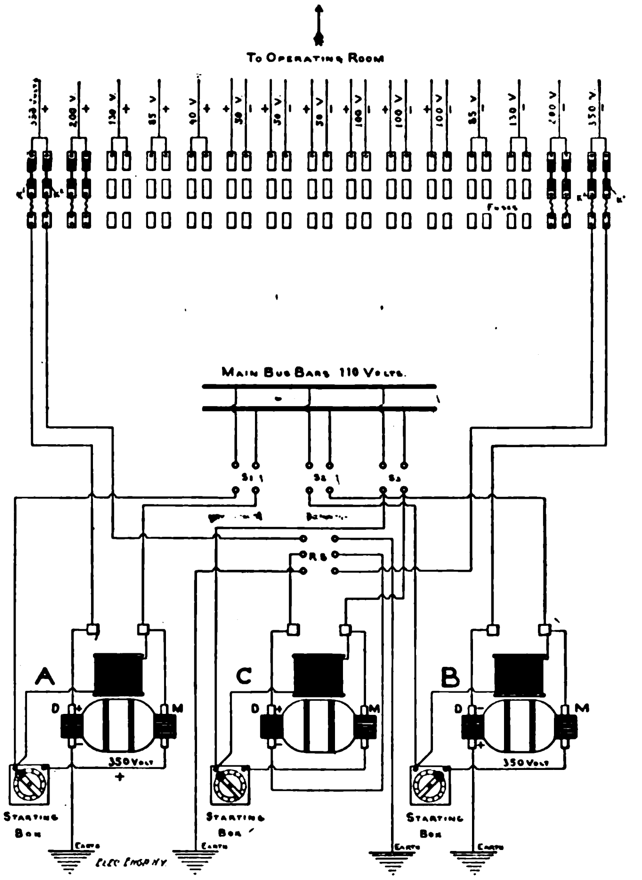


FIG. 4.—CONNECTIONS OF TELEGRAPH DYNAMOS TO SWITCHBOARD AND OPERATING ROOM.

situated the resistances to protect the circuits fed by the intermediate machines; these resistances are of German silver mounted on tin cylinders. This board was manufactured by the Western Electric Co.

After passing through the board the wires are connected to two 14-wire cables leading to the operating room above, one carrying the plus, and the other the minus currents. To these there is added a No. 0 B. & S. wire which carries the current for the 40 volt local circuits. There is also a No. 00 B. & S. ground wire run to the operating room.

V.—THE UNDERGROUND CABLE ROOM.

The line wires enter the basement from the subways in the street in cables encased in wrought iron pipes. There are ten of these cables, containing from 80 to 100 wires each, which are carried directly to the cable room in the basement, making a straight run to the terminal board there situated. Here they end in the cable terminals, and before passing to the distributing board the circuits pass through lightning arresters, consisting of a broad mica plate, and through fuses to protect them against other abnormal currents. The wires then pass to the distributing racks directly behind the terminal board where they are connected to the proper circuits leading to the switchboard in the operating room above. After leaving the distributing rack, the wires are again gathered into cables of about 50 wires each and, after taking a gentle turn, are carried straight up to the operating floor through a well specially provided for that purpose.

Special provision has been made to take the strain off

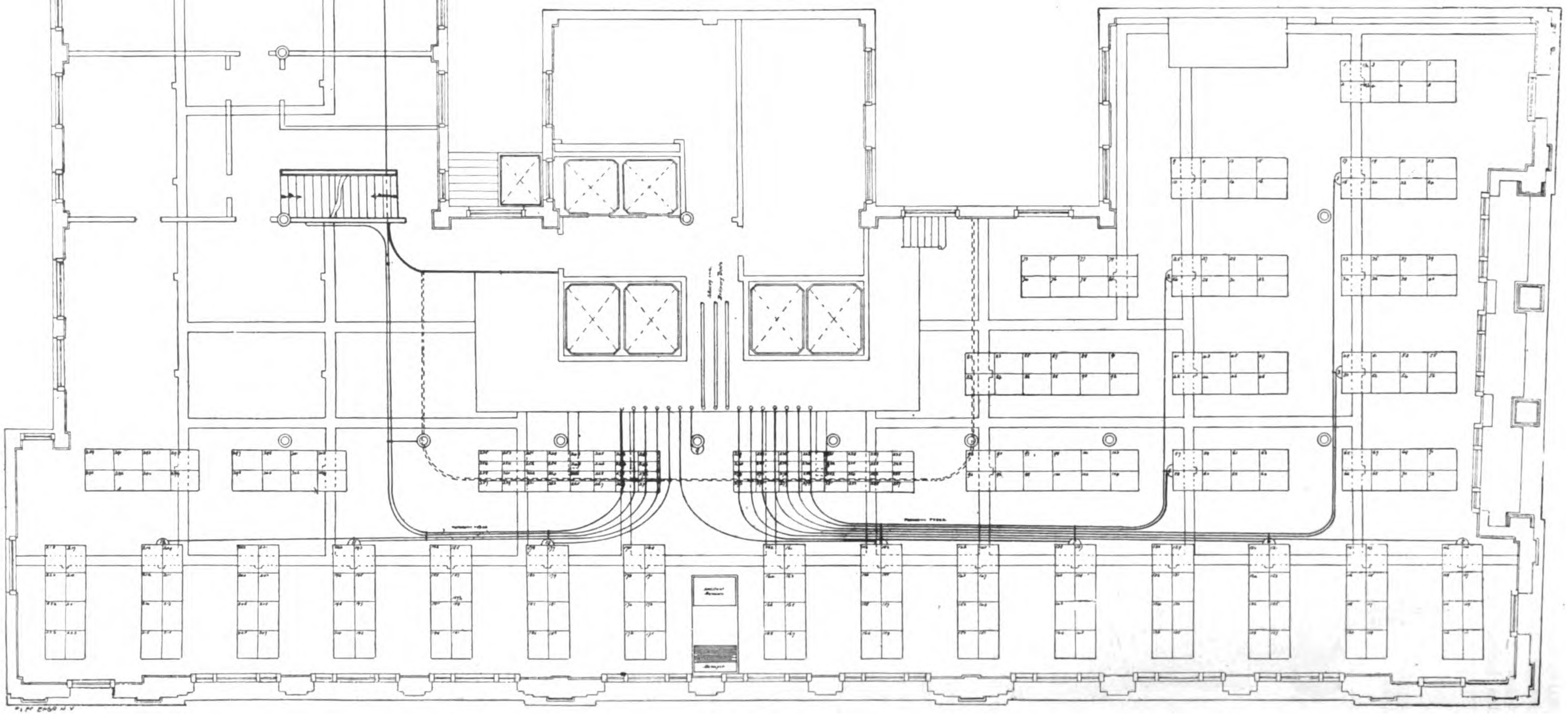


FIG. 5.—PLAN OF OPERATING ROOM, 12TH FLOOR, SHOWING ARRANGEMENT OF TABLES, PNEUMATIC SYSTEM, ETC., POSTAL TELEGRAPH BUILDING.

these cables and this has been accomplished in the following way: At the top of the well a heavy steel bar is supported horizontally, to which are fastened ½ inch galvanized iron stranded ropes, corresponding in number to the number of cables and which extend down to the cable room. At each floor the cables are bound to the wire ropes by marline tow closely wrapped around both. Being thus supported at each floor, as it were, the cables reach the top without any strain on them whatever and are taken under the floor to the back of the switchboard. The cable well is accessible at each floor, so that, if necessary, the cables can be examined at practically every foot of their run.

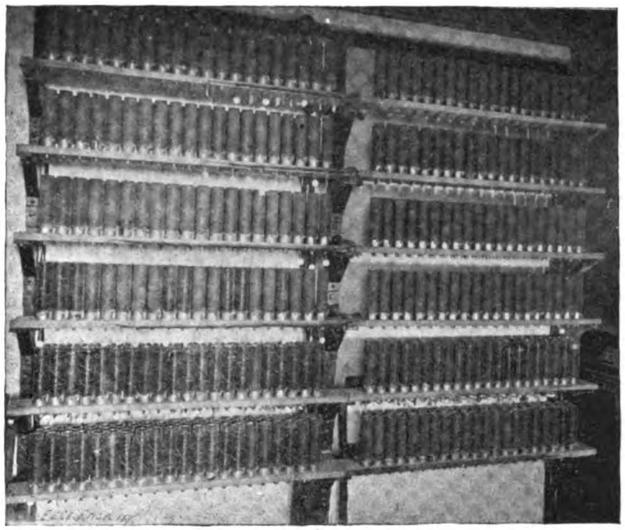


FIG. 6.—RESISTANCE COILS, MAIN SWITCHBOARD.

In addition to the cable room devoted to the purposes of the Postal Telegraph Co., another similar room has been specially provided for the accommodation of telephone, messenger, ticker, and other similar service. The wires of these companies are also brought in by separate conduits from the street, thus leaving the company's service entirely distinct and separate.

VI.—THE OPERATING ROOM.

To those who are accustomed to link the idea of a telegraph operating room with any space capable of holding tables and chairs, the superb operating room on the 12th floor of the building will be a revelation. It extends the entire length of the building—156 feet and crosses the whole front of the building, 70 feet, facing on Broadway, overlooking City Hall Square on one side and the Hudson River and New York Harbor on the west. The ceiling is 18 feet high as already stated; and, with the large windows provided, the light is practically equivalent to that outdoors. The floor space is laid out in standard octet tables made of cherry, which wood is also used for all the switchboards. Situated in the centre of the room is the main switchboard and directly in front of it are the tables containing the repeater sets. Directly opposite these, near the wall, is the manager's table, raised on a platform so that he can readily overlook the entire floor. Near the Broadway wall is the city switchboard. See Figs. 1 and 5.

VII.—THE MAIN TELEGRAPH SWITCHBOARD.

Let us now return to the cables entering the operating room at the back of the main switchboard. Taking first the 14-wire dynamo cables, they are led to a small distributing board, at the back of the main board, and thence under the floor to the main switchboard, one to each panel of the board. They are there connected to a common ter-

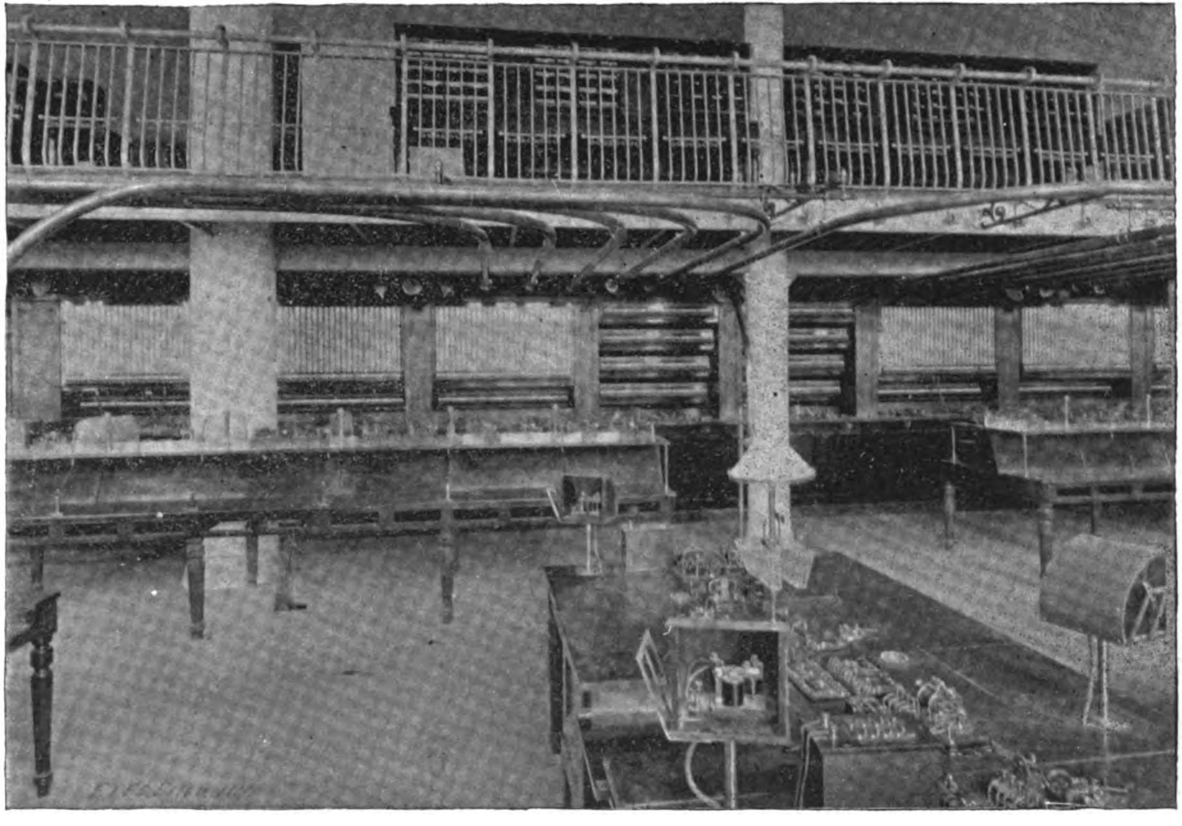


FIG. 7.—MAIN SWITCHBOARD IN POSTAL TELEGRAPH OPERATING ROOM, FRONT VIEW.

minal, or bus bar, mounted on a slate base, upon which the resistance tubes are mounted, Fig. 6. From here they pass to the discs on the board and are there plugged to the wires as desired.

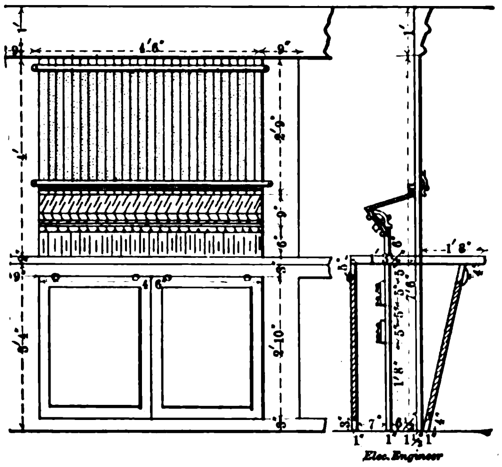


Fig. 8.—Main Switch—Rear and End Elevations.

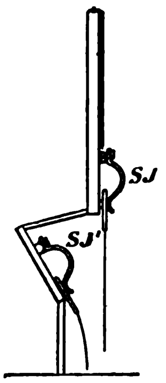


Fig. 9.

It may be remarked that, as in the case of the dynamo board in the basement, the safety resistances employed consist of German silver wire wound on tin tubes perforated at the bottom to afford ventilation. It might appear that the use of such resistance, in place of incandescent lamps which have been largely introduced for that purpose, might be considered a step backward. But the experience of the electricians of the company has warranted this step. It is said that the filaments change their resistance in time, that they are subject to breakage and thus introduce uncertainties in operation, which have proved very annoying. Hence the return to German silver.

The main switchboard, Fig. 7, is made of marbleized slate, and enclosed in cherry; and Figs. 8 and 11 show some of the details of construction. It is divided into 14 panels. Six panels, counting from either end, are arranged for 50 wires each, with 30 rows of discs and 50 straps. These constitute the main line switches. The two centre panels contain the loop or "leg" switches, by means of which any two sets in the office can be connected for repeating, as well as to connect branch offices on the sides of a multiplex circuit. These two panels contain four double rows of 88 jacks each. The arrangement of this switchboard is similar to that adopted by the Postal Telegraph Co. some time ago, and constitutes a departure from the type which has been used for many years previously in the United States. The present construction will be seen in Fig. 9. Here, it will be noted, the lower row of spring jacks is inverted ; this permits of the tablets and markings to be plainly seen by the chief operator, so that connection can be made with unerring exactness, while, in addition, it avoids the sharp bend in the connecting cords which frequently broke from that cause, as arranged under the old system.

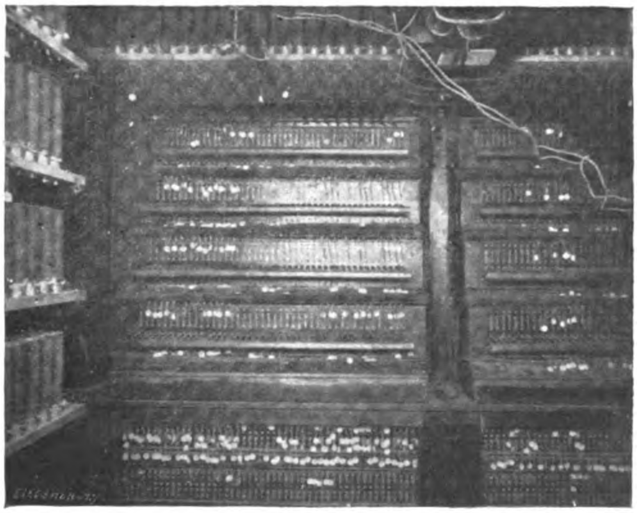


Fig. 10.—View of Rear of Main Switchboard.

Directly in front of the main switchboard are two tables, each 18 feet long by 4 feet wide, containing the repeater sets arranged in two tiers. The divisions between each of these sets consist of plate glass supported by small brass standards at the base, which avoids the use of the somewhat clumsy frames heretofore employed. The wires from the main board and other parts of the room are led up through the centre of each table and are distributed in a trough which runs along in the centre of the table, forming a trapezium. There are 32 spaces on each table, containing the usual repeater, quadruplex or duplex sets. See Fig. 19.

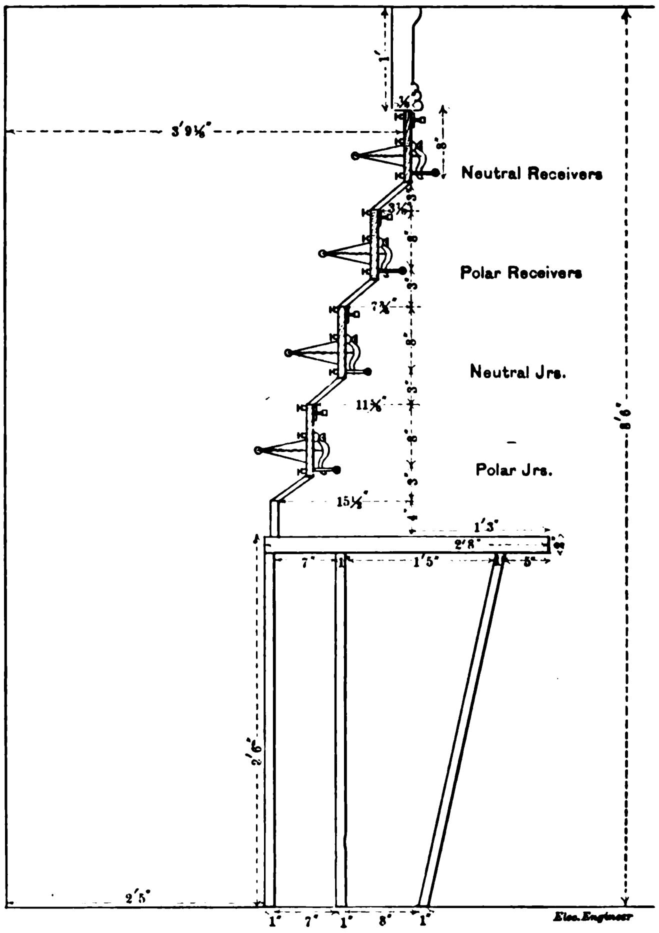


Fig. 11.—Leg Switch, Vertical End Section.

VIII.—THE OPERATORS' TABLES.

As stated above, the standard table adopted in the room is an octet, or double quartet, Fig. 12. From each of these tables there is run a twenty-six wire cable to the switchboard where it ends in a cable made with twenty-six terminals placed under the switchboard. From this cable the conductors are led to the cords, locals, etc. All the tables are fitted for the use of the typewriter machine, which is supported on a sliding shelf devised by Mr. W. H. Baker, which forms a part of the table proper, but when slid out and inserted in the special slide provided for that purpose brings the level of the machine to the proper height. The use of the typewriter in the Postal Telegraph offices, it may be remarked, has become quite general. It is found to be a great relief to the operators, who are able to do their work more quickly and accurately than by hand. The machines are the property of the operators, and each table contains eight small closets for the reception of the machines when not in use.

It will also be observed that the usual partitions heretofore employed in the quartet tables are here missing. One of the objects of the partitions was to confine the signals of the sounder so that they should not interfere with those of the operator's neighbor, but this has become unnecessary since all the sounders are housed in resonators.

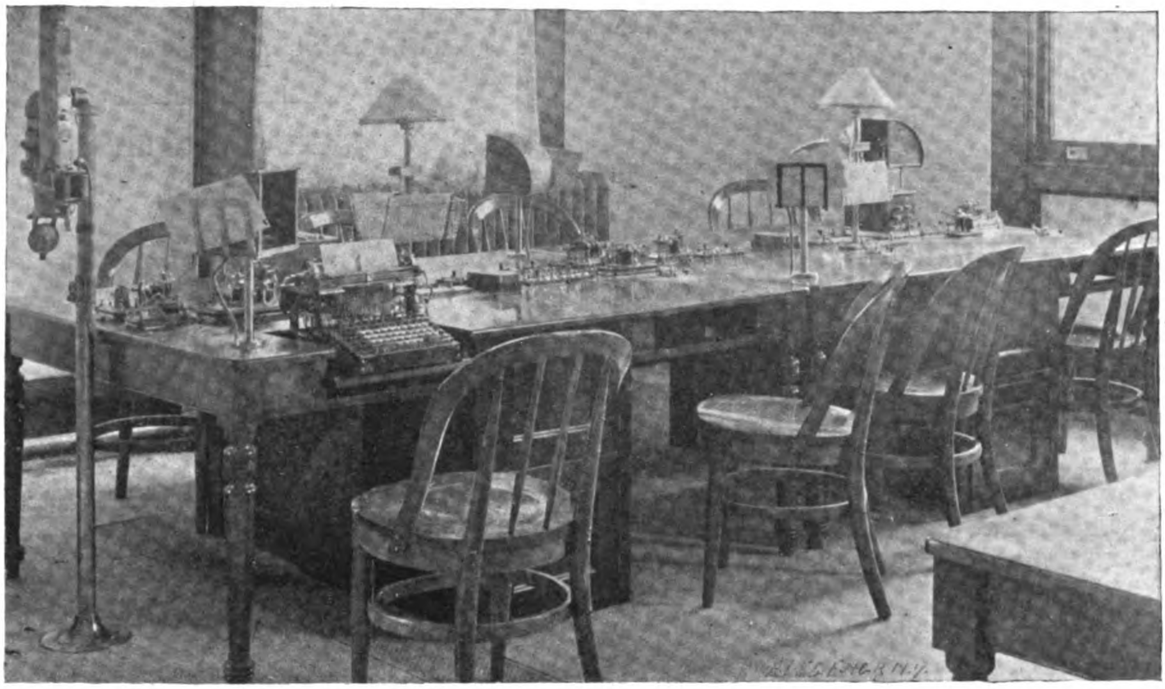


FIG. 12.—POSTAL TELEGRAPH STANDARD OCTET OPERATORS' TABLE.

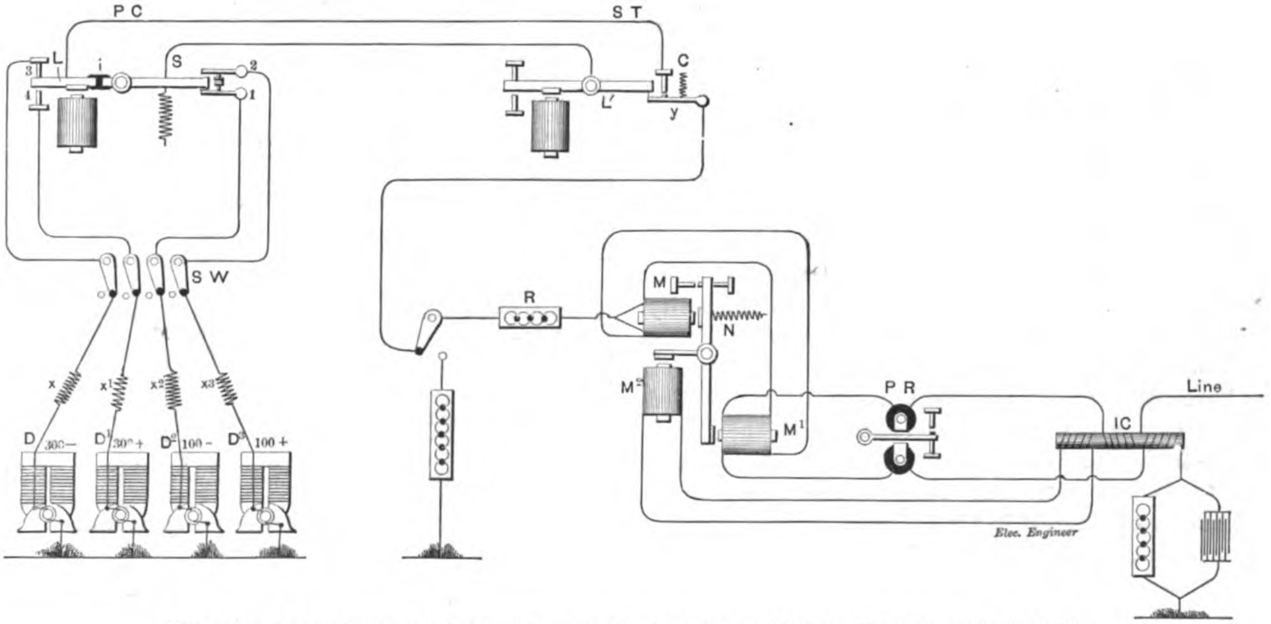


FIG. 13.—JONES DYNAMO QUADRUPLEX AS EMPLOYED BY POSTAL TELEGRAPH-CABLE CO.

The general arrangement of the main line instruments on the quadruplex tables is much the same as that heretofore in vogue, with a few notable improvements, which facilitate the chief operators' work. The most noticeable of these is the arrangement whereby the condensers are dropped in through the centre of the table, their ends, with the discs and numbers of plates on, being flush, or nearly so, with the top of the table. This is rendered possible by the abandonment of the partitions, which also gives free access to the binding posts of every instrument.

The main line instruments are of the Western Electric Company's make, the keys, sounders and switches being manufactured by J. H. Bunnell & Co. These switches are mounted on hard rubber, are heavily plated, and are provided with a specially designed spring clip ensuring an absolute contact.

The resonator or hood in which each sounder is placed is mounted on a brass standard eight inches in height, which is secured under the table by a wing nut. This standard is

(Continued on page 347.)

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.
United States and Canada, - - - - - - - - per annum, $3.00
Four or more Copies, in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - - - - - - - - - - .10
[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

VOL. XVII. NEW YORK, APRIL 18, 1894. No. 311.

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THE NEW POSTAL TELEGRAPH BUILDING AND ITS PLANT.

THERE is a tendency among electrical engineers to look upon the field of telegraphy as hackneyed and uninviting. By the ordinary electrician it is assumed that the art has little that is new to offer; by the public it is assumed that the telegraph, being a "monopoly," is unlikely to foster and develop anything really novel or meritorious. The fact is, however, that on its technical side, the telegraph is progressive, not perhaps so much so as the newer electrical arts, but still capable of demonstrating steady improvement. Upon the commercial side of the industry, the Postal Telegraph-Cable Co. by a continuous existence in opposition and competition for more than ten years, as well as by its swift strides in prosperity and importance, has shown that there never was a time when a better rivalry existed than to-day.

We have devoted our current issue to a detailed description of the new headquarters in which the Postal Telegraph-Cable Co. has established itself this week, and venture to believe that our readers will find a great many features of interest in the exhaustive article that so fully occupies these pages. As a simple matter of fact, it may be stated that the Building exemplifies in a variety of ways the latest advances in a wide range of electrical arts, many things having been done there that had either not been done before, or had not been done on so large a scale. The telegraph plant possesses many new features and improvements, and the electric elevators, the dynamotors, the generating plant, the switchboards, the lighting, the wiring, etc., are all the latest and best of their kind. It is a matter of congratulation thus to find a company engaged in the oldest electrical industry able, by means of its success and its intelligent management, to encourage the most recent developments in the newest electrical industries, and thus to manifest how strong a bond of union exists between them all.

LEGAL NOTES.

FEEDER AND MAIN PATENT LITIGATION.

EDISON ELECTRIC LIGHT COMPANY *vs.* F. P. LITTLE ELECTRICAL CONSTRUCTION AND SUPPLY COMPANY, THE BINGHAMPTON STATE HOSPITAL, *et al.*

EDISON ELECTRIC LIGHT COMPANY *vs.* E. G. BERNARD COMPANY, ISAAC ARNOLD, JR., *et al.*

UNITED STATES CIRCUIT COURT, NORTHERN DIST. OF N. Y.

ON Motions for Preliminary Injunctions: Judge Coxe, sitting in New York, Wednesday, April 11, 1894, declined to enjoin the F. P. Little Electrical Construction & Supply Co. It appeared that most of the directors of the F. P. Little Company were also directors in the Buffalo General Electric Company and not in a position to contest the validity of the Edison patent. Judge Coxe imposed a bond of $5,000 upon the defendants as security for possible damages.

In the Bernard case the Court sustained the demurrer of the E. G. Bernard Co., viz., that the suit was on nine patents and too multifarious. This disposed of the motion for injunction for the present. Judge Coxe allowed the complainants twenty days to amend their bill.

INJUNCTION UNDER THE EDISON FEEDER PATENT.—EDISON ELECTRIC LIGHT CO. vs. THE N. Y. INS. WIRE CO.

In the U. S. Circuit Court, in this city, last week, Judge Coxe granted an injunction, against the New York Insulated Wire Co., under the Edison patent No. 264,642, of Sept. 19, 1882, relating to feeders. This is understood to relate to the work done under contract at the World's Fair by the New York Insulated Wire Co., who, however, state that they are not in the construction business themselves, being simply manufacturers of insulated wires, cables, tapes, etc.

SOCIETY AND CLUB NOTES.

AMERICAN METROLOGICAL SOCIETY.

THE annual meeting of the American Metrological Society will be held in Washington, D. C., on Friday, April 20, at 2 p. m., at the Columbian University.

Prof. T. C. Mendenhall will report on the International Electrical Congress at Chicago. Prof. A. A. Michelson will give an account of his work at the International Bureau (near Paris) in determining the value of the metre in terms of wave lengths of light. The Committee on Color-Standards will make an interesting report.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE 86th meeting of the Institute, will be held at Headquarters, 12 West 31st Street, New York City, on Wednesday, April 18th, at 8 p. m. A paper will be presented by Mr. I. H. Farnham of Boston, on the "Destructive Effect of Electrical Currents on Subterranean Metal Pipes." The paper will be fully illustrated with lantern slides. Prof. G. W. Plympton of Brooklyn, has been invited to open the discussion. In order to utilize the lantern slides at Chicago, the meeting of Western members in that city will be deferred until Wednesday, April 25, at 8 p. m., at the Armour Institute, 33rd Street and Armour Avenue. Mr. Arthur V. Abbott of Chicago, has been invited to read the paper at the latter meeting. Mr. B. J. Arnold will open the discussion.

ELECTRICITY IN RELATION TO THERAPEUTICS.

MR. H. NEWMAN LAWRENCE, Member Institution Electrical Engineers, England and Fellow American Electro-therapeutic Association, proposes to deliver a course of ten lecture demonstrations on the above subject, at the Brooklyn Polytechnic Institute, commencing Wednesday, April 18th, at 4 P. M., providing a sufficient number enter for the class. The remaining days (either one or two per week) and time will be arranged as far as possible to meet the convenience of those attending.

(*Continued from page* 345.)

separated from the table by a soft rubber washer on each side and tubing through the hole in the table of the same material to prevent transmission of sound through the table top. The back of the hood is made of indurated fibre, this being found to have excellent damping qualities, the sounder signals being desired from the open side only of the resonators. To the side of the hood is attached a spring holder in which the received messages are placed. Baskets of wire attached to the brass lamp fixture in the centre of the table take the place of hooks for the reception of messages to be transmitted, each basket having a card holder, in which appears the name of the office in communication with that table. The main line currents are brought to the table in cables distinct from the other wires, which terminate on hard rubber base switches. Each quartette table is lighted by an incandescent lamp and the general illumination of the room is effected by Lemaire arc lamps suspended at a height of 10 feet 6 inches from the floor.

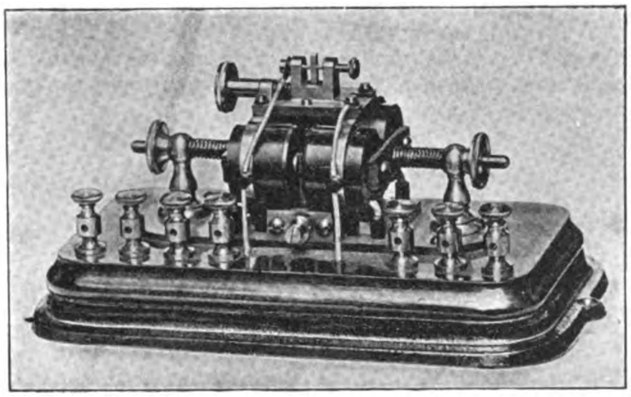


Fig. 14.—Jones Polar Relay.

IX.—THE QUADRUPLEX, REPEATING AND LOCAL CIRCUITS.

The quadruplex system employed on the Postal-Telegraph lines is that devised by the chief electrician of the Company, Mr. Francis W. Jones, and is shown diagrammatically in Fig. 13. Here D, D', D², D³ represent four dynamos. Two of these dynamos are of low potential (one plus and one minus) and two are of high potential (one plus and one minus), and they are connected to a new style of pole-changer, marked P C, through a four-button switch S W.

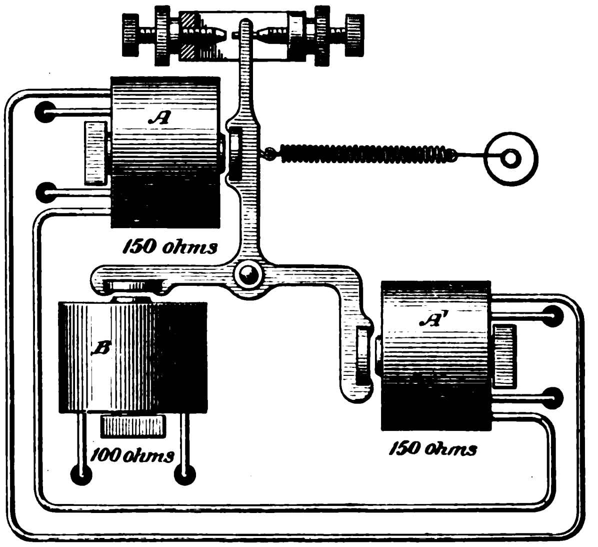


Fig. 15.—Jones Quad. Triple Magnet No. 2 Relay.

P C makes four contacts, 1 and 3, when it opens, and 2 and 4 when it closes. Contacts 1 and 2 are adjustable springs and continuity preserving, as the end S of the lever of P C moves up or down. The contacts 3 and 4 are fixed, and a space occurs when the end L of P C moves from one to the other. The ends of lever L and S are insulated by *i* from one another. It will be seen that the dynamos are connected as follows: One hundred minus to contact 1, one hundred plus to contact 2, three hundred minus to contact 3, three hundred plus to contact 4. Two wires lead from P C to an improved form of single transmitter S T. One wire connects L with contact point C, the other wire connects S with the lever L¹. The spring *y* of S T connects through a three-point switch, and a regulating resistance R with the dividing point of the relay N. P R is a polarized relay, and I C is an induction coil having three windings of one hundred ohms each. Two of these windings are included in the main and artificial circuits in the usual differential manner. The third winding is connected with the third electromagnet, marked M², of the relay N.

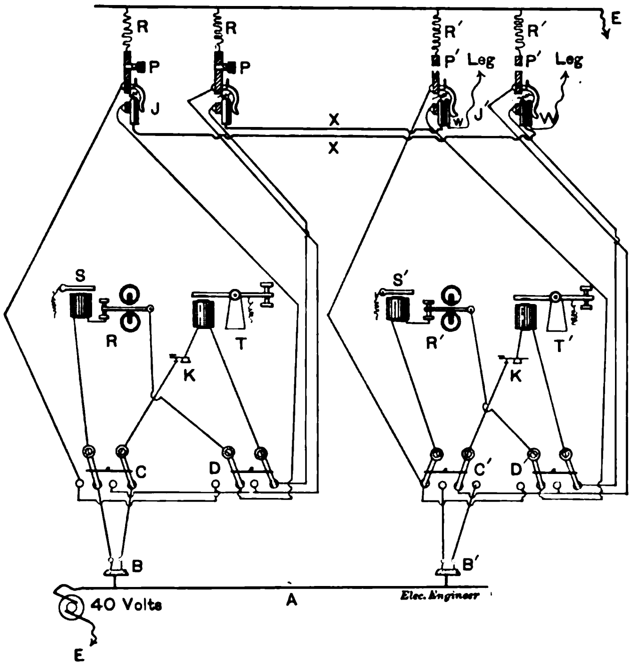


Fig. 16.—Postal Telegraph Standard Quadruplex—Local Connections.

The electromagnets M and M¹ are in series differentially in the line and artificial circuits, the total resistance of both magnets in either circuit being about 300 ohms. The polar relay P R shown in perspective in Fig. 14, has the usual resistance of 400 ohms in each winding.

The resistance R between the three-point switch and N is for the purpose of reducing the potential of the dynamos when it is desired to work a line circuit of shorter length than is designed for the normal potential of the machine. Thus from the same dynamos several quadruplex circuits of varying lengths or resistances may be worked, provided the normal potentials of the machine are adapted to the circuit of highest resistance. The diminution caused to the incoming current by the insertion of R is counterbalanced on the relays largely by the greater quantity of the incoming current that will go to earth *via* the artificial circuit, thus traversing two sets of relay convolutions.

Number 2 relay, N, is shown on a large scale in Fig. 15; A and A¹ are the differential main line electromagnets connected up in series. B is the electromagnet through which the secondary circuit of the reversal coil I C, Fig. 13, is connected. The lever of the relay is made of aluminum and carefully counterbalanced by giving the armature lever of

A^1 an angular shape. An inspection of Fig. 13 will show that the outgoing currents passing differentially around the reversal coil I C produce no effect upon the third winding connected with magnet M^2. The incoming signaling current, however, during its approach and retreat sets up in the secondary coil of I C induced currents which momentarily energize electromagnet M^2 which holds the lever of the relay in opposition to the force of the retractile spring.

The local circuit and repeating arrangements are new, and very simple in operation, and the system is thought to be much in advance of any at present used, being perfectly elastic. The locals of any set in the room can be made to repeat into those of any other set and while so doing can be cut clear of the other set, at either table, for the purpose of balancing, etc. The arrangement also permits a set of loops or single legs to a branch office to be put on, while so repeating, to take a drop copy, the office at which these legs terminate having the same control over the circuit as the main office has. Legs to branch offices can also be connected to any set, giving them the same facilities as the main office on that set. The connections are shown in the accompanying conventional diagram, Fig. 16, showing the table instruments and switches and the spring jack connections at the loop switch, or, as it is termed, by Postal chief operators, the "leg board." The main lead A of the 40-volt local machines runs past all table pockets of the wire ducts in the floor, and is tapped at each pocket by a wire running to a fuse block on the table, as shown at B and B^1. From the fuse block taps are made for each local circuit on the table. The regular connections are from the fuse at B to the 3-point switch C, thence through the key K and the local magnet of the transmitter T to the fixed post of the 3-point switch D; from there to the spring jack J at the leg board and thence normally through the pin P and the 150 ohm resistance R to the ground. All legs to branch offices which are to be worked on duplex and quadruplex sets are equalized to this resistance and are brought to the board on single cords and wedges under the jacks at J and J^1. The insertion of a wedge with its metallic face down on the shoe cuts out the upper portion of the spring jack, completes the circuit through the leg to the ground at the branch office, and gives the operator there control of the circuit.

When it is desired to have the locals of one set repeat into the locals of another, as, for instance, to give Boston a through Chicago connection, the switch to the left on one of the sets is thrown to the left, as shown at C^1. This throws the current off and substitutes the resistance R^1 for it. A flexible cord with a wedge at each end then connects the two jacks of the sets that are to repeat. The circuit now, instead of being completed through the pin P and resistance R to the ground, is extended through the cord X to the shoe of the jack at J^1, thence to the 3-point switch D^1, through the local points of the relay R^1, the magnets of the sounder S^1, the 3-point switch C^1, through the pin at P^1 (not shown in the sketch) and the resistance R^1 to the ground. In this way the armature of the relay R^1 operates the transmitter T. Fig. 17 shows the main line connections.

It is frequently desired to take a copy of matter passing through from one circuit to another in this manner, as, for instance, in a newspaper special where the same matter is to be transmitted from Washington to both New York and Boston. By removing the pin at P^1 and inserting the wedge W with its metallic face upwards, the circuit is completed through the leg to the branch office in place of the resistance R^1. It often happens when sets are repeating into one another that it is desirable to cut one set clear of the other

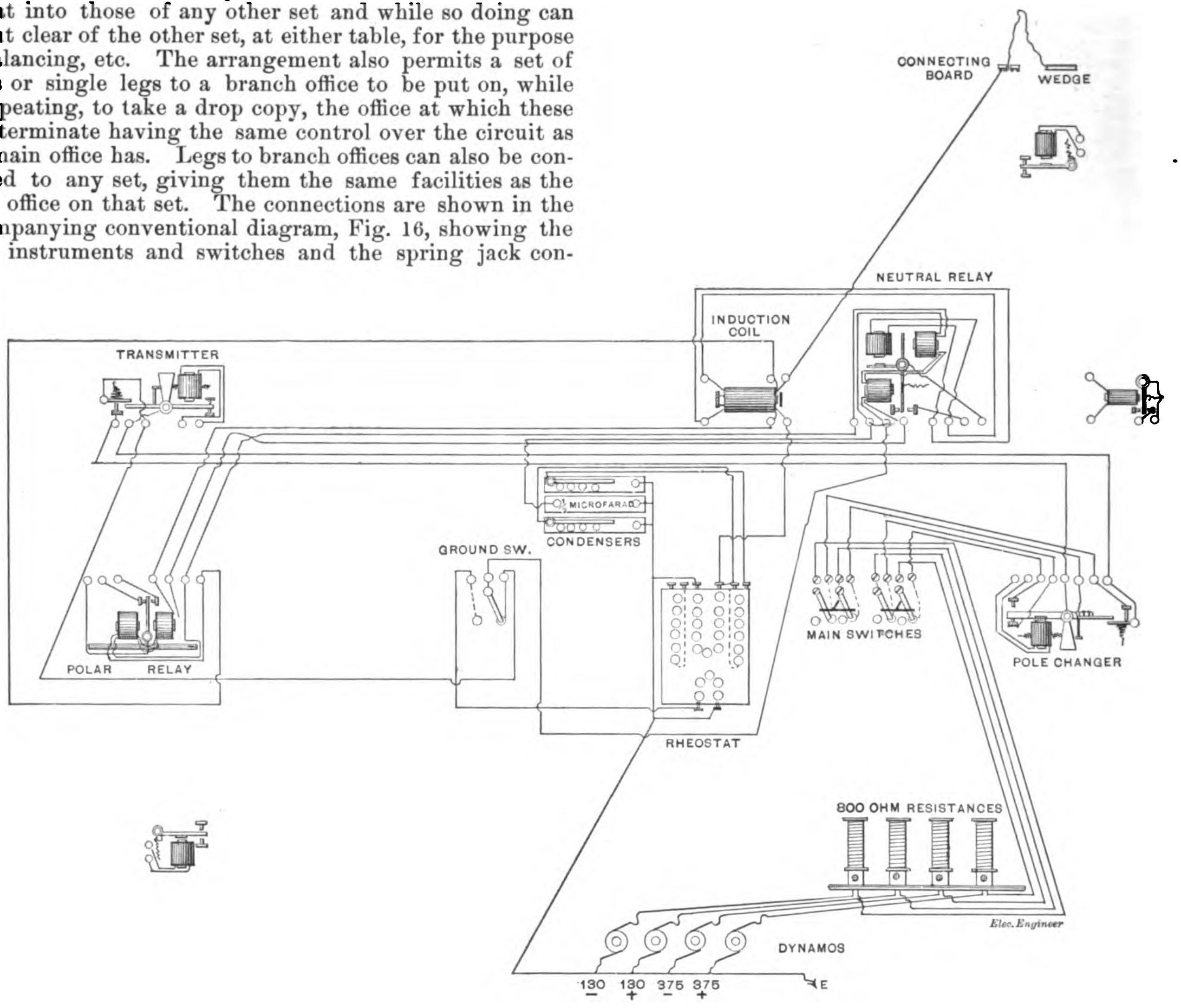


FIG. 17.—POSTAL TELEGRAPH STANDARD QUADRUPLEX—MAIN LINE CONNECTIONS.

to balance or adjust instruments. Heretofore it has been necessary to run to the leg board and make changes to enable one to do this. By throwing the switch D to the left, the jack is shunted out and the circuit completed through the pin P and the resistance R direct, debarring all interruption from either the other station or the branch office. This can be done at either set by throwing both switches towards the centre. One side of the diagram only has been referred to, the other being identical. Every contingency is provided for by this arrangement.

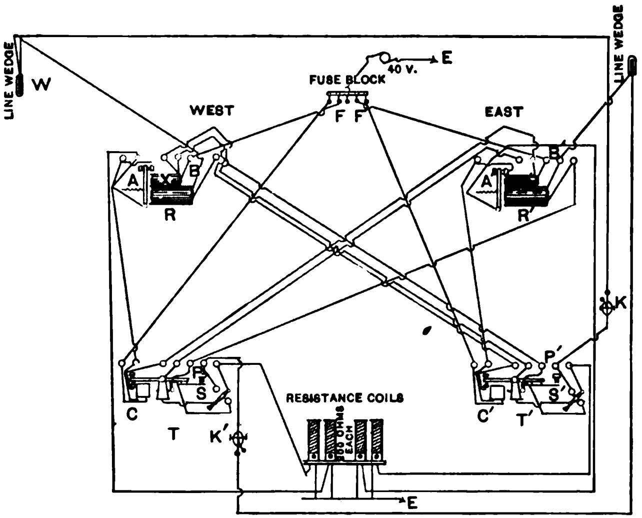


FIG. 18.—WEINY REPEATER ARRANGEMENT, POSTAL TELEGRAPH SYSTEM.

The Weiny repeater is used for Morse wire repeating purposes. These sets comprise two Weiny relays, two transmitters and two keys. The relays are constructed with three coils, two corresponding to those of a regular Morse relay and wound to 250 ohms; the third, differentially wound, being located on top of and between the other two. This third coil has an adjustment independent of the lower ones, and is wound to 20 ohms each way. The local points of each relay control the magnets of the corresponding transmitter. These locals are fed in the same manner as the Morse set locals, from the fuse block on the table, their circuit being completed through a 200 ohm coil back of the main switchboard to the ground.

Referring to the diagram, Fig. 18, the wedges W and W^1 are located under the spring jacks of the switchboards. On inserting the wedge W in the line jack the circuit is extended through the main coils of relay R, thence to the spring point S^1 of the transmitter T^1 (which is controlled by relay R^1) through the post P^1 and the key K to the other face of the wedge and to the line. The other line is put through the wedge W^1 in the same manner, It is evident that the movements of the armature A of the relay R, controlling transmitter T, will operate the circuit made through the wedge W^1, by opening and closing the points of post P and spring contact S, the other circuit being operated by armature A^1 of relay R^1 in the same manner. The deadlock which would ensue by both armatures falling on the back stop is prevented by the extra magnets X and X^1. The current fed through the fuse F splits on the post B and passing differentially through X the ends go to transmitter T^1, one connecting to the bar direct, the other through the post C^1 to the same bar, the circuit terminating through a 200 ohm coil to the ground. With either transmitter closed, the corresponding extra magnet is dead, the differential coils neutralizing one another. When the armature A^1 and relay R^1 is released, opening transmitter T^1 and also the circuit of wedge W, the tendency of the armature A and relay R to fall back and create a deadlock is checked by the extra magnet X, which, immediately on the opening of the transmitter T^1, cutting one side of its differential coils at C^1, becomes an active magnet holding the armature A^1 down until transmitter T^1 is again closed. A convenient four-point switch is attached to the base of each transmitter which cuts the main lines clear of each other and by the same motion throws off the extra locals. Fig. 19 shows a section of one of the repeater tables.

X.—THE PNEUMATIC DISTRIBUTING SYSTEM.

In an office of such magnitude, handling thousands of messages per hour, it is of the utmost importance that the messages be distributed with dispatch and with the least amount of physical manipulation by individuals. This has been accomplished by the application of the Miles pneumatic tube system which connects the gallery and the operating room with the operators and with the receiving offices on the first floor of the building. The gallery, in fact, contains twelve pneumatic tube inlets which connect with the operating floor; three to the receiving department on the ground floor; one to the executive offices, and one to the book-keeping department. The mechanical operation of this system is well worthy of a short description which will be aided by referring to Fig. 20. An air pump feeding an air reservoir delivers pressure at two pounds which is carried all about the room to the various outlets of the operators' tables. At each station there is a combination valve shown at A V and S V. When no carrier is passing through the tubes, the stop valve S V is open and the air valve A V closed, so that when no messages are being carried no air is wasted. When the carrier is inserted in the tube, however, the stop valve S V is thrown over and closes the tube outlet at the station, the valve being held closed by the spring latch L. This same movement, however, opens the air valve A V and admits the air pressure behind the carrier which is sent on its way through the tube until it is thrown out at the other end. Each end of the tube is provided with similar valves. In order to relieve the operator of the necessity of opening the stop valve, or rather closing the air valve, when the carrier has arrived at the other end,—which would be necessary in order to avoid the loss of air pressure,—an electrical device has been introduced by Mr. Jones consisting of an electro-magnet M and the spring S inserted in the path of the carrier.

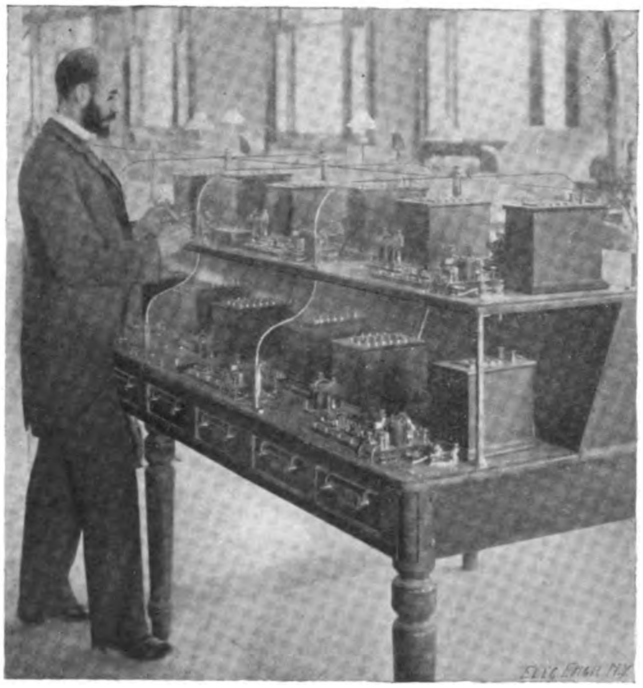


FIG. 19.—A SECTION OF THE REPEATER TABLES.

Normally, the circuit of the electro-magnet is open. When the carrier, starting from the lower end of the tube, for instance, reaches the other end it presses the spring s′ against the contact and closes the circuit. This energizes the magnet M which attracts an armature attached to the latch L. This releases the stop valve S V which, in falling, closes the air valve. Fig. 21 shows in section the actual construction of the air valve.

Besides this expeditious method of handling messages between the gallery and the floor, a very effective system has been arranged for handling and distributing messages in the gallery itself. We can best illustrate this by taking the case of a message, say, from Washington to Boston. When the message reaches the New York office from Washington it is sent by tube to the gallery from the table upon which it is received. A boy takes it from the tube and gives it to a clerk seated before a rack of pigeon holes open at both sides and numbered to correspond with the tube that goes to the Boston table on the floor below. Another boy then takes the message from the back of the pigeon hole and puts it in the tube corresponding in number to the pigeon hole from which he took it, that is, the number of the Boston table. Arrived there, it is transmitted by the operator to its destination. There are six racks of these pigeon holes identical in shape, and identically numbered; thus, when there is a heavy rush of business, six clerks can be employed simultaneously to distribute the messages in proper pigeon holes, without one interfering with the other; while, when business slackens up towards the end of the day the number can be reduced correspondingly, the arrangement being such that just the required number can be kept at work to suit the amount of business at any one time. After the messages have been transmitted by the operators they are gathered up by boys and brought up into the gallery and classified alphabetically in pigeon holes and remain there during the day on which they originated, easy of access for inspection and correction, if necessary. On the night of the same day they are all transferred to a duplicate set of pigeon holes where they remain twenty-four hours. They are then bundled and taken to the book-keeping department. The gallery also contains a desk for the service clerk.

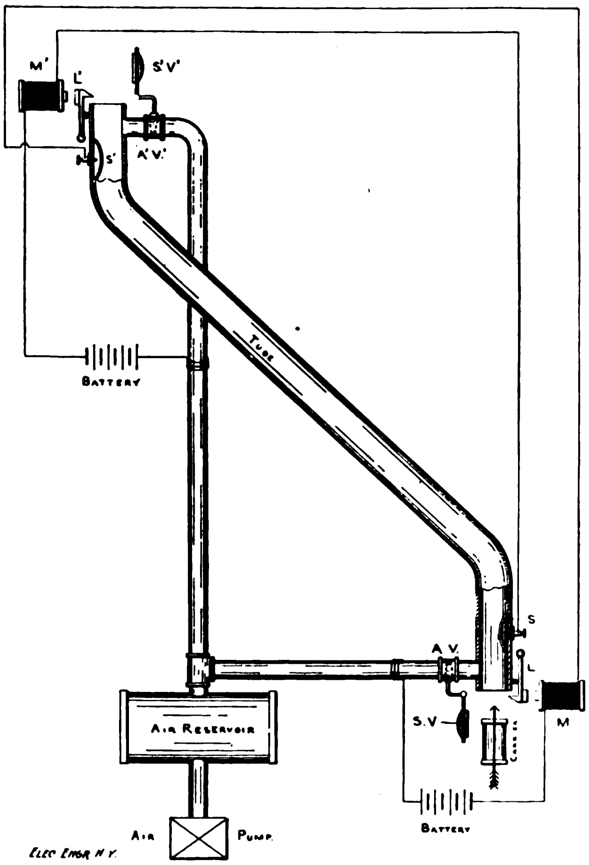


FIG. 20.—DIAGRAM SHOWING ARRANGEMENT OF PNEUMATIC DISTRIBUTING SYSTEM.

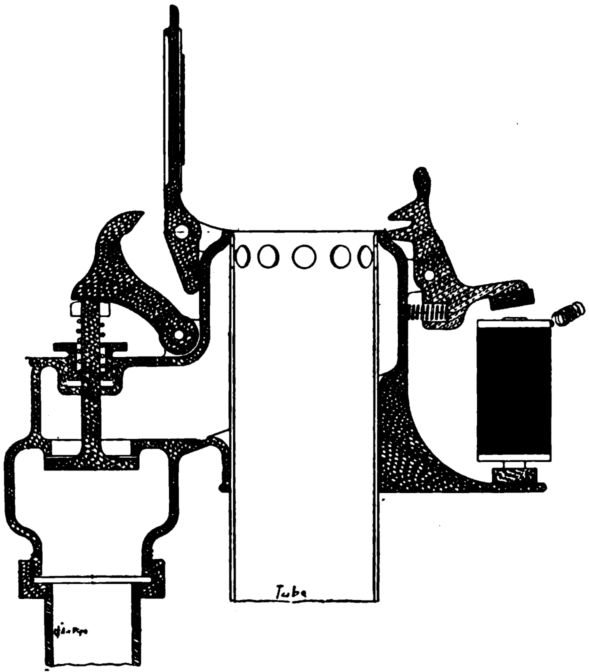


FIG. 21.—SECTION OF PNEUMATIC VALVE.

The Company has also looked well after the comfort of its employees; retiring rooms being fitted up for both male and female operators, all of whom are provided with lockers, built of iron lattice work thus permitting thorough ventilation, and each provided with individual locks. A space has also been laid ont for a restaurant. Back of the operating room is the book-keeping department in which the cable accounts are kept of the entire lines, and all New York City business. Here also are provided storage rooms for the messages, which are kept six months before being destroyed.

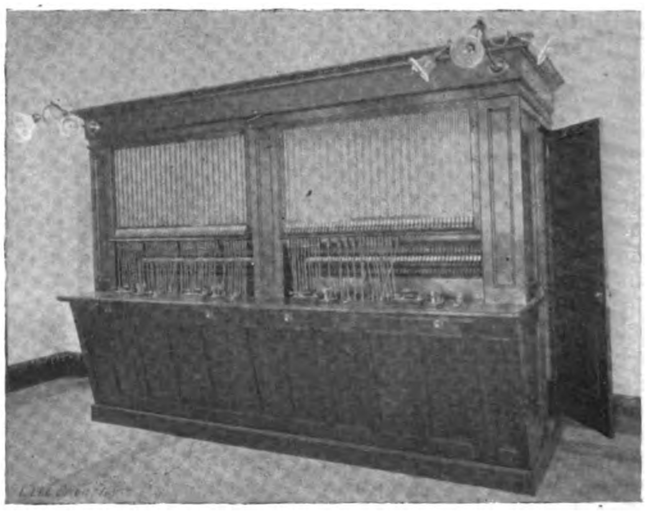


FIG. 22.—THE NEW YORK CITY SWITCHBOARD.

There are sixty branch offices of the Company in New

York City and for their use a special switchboard, Fig. 22, is installed at the east end of the room. A special board has been provided to equalize the resistance of the branch loops or legs, so that they can be brought up to any desired resistance, or reduced, as may be necessary.

The entire work involved in the telegraphic equipment was designed by or carried out under the supervision of Mr. Francis W. Jones, chief electrician of the Postal Telegraph Cable Co. In this he was ably assisted by Mr. Minor M. Davis, assistant electrician, who had immediate charge of the wiring and carried out the plans and equipment of the operating room. Mr. John F. Skirrow supervised the running of the wires to the tables and the proper connection of the instruments, a work requiring much care and ingenuity. Mr. H. Gref, an old employé of the Company devoted his attention specially to the wiring behind the switchboard, in which particular work he is said to have no superior. He was ably assisted by Mr. Arthur d'Romtra.

XI.—THE SPRAGUE-PRATT ELECTRIC ELEVATORS.

As complete, perfect and interesting as are the various electric equipments of the Postal Telegraph Building, there is none which is of more interest, whether regarded as a remarkable mechanical and electrical combination, or as the forerunner and prototype of a new industry, than the Sprague-Pratt electric elevator plant.

All other features mark a perfection of detail in industries and practices already well known but brought to refinement by years of development and with precedents sufficiently numerous to involve no material risk in their adoption. The electric elevator for high speed duty was, however, an unsolved problem, and one which the combined knowledge and prophesies of somewhat antagonistic interests declared to be beyond the possibility of electromechanics.

It is hardly necessary to say that in view of this state of affairs, which much resembled that existing when the Richmond Electric Railroad was first projected, the decision to depend upon electricity for the service of a building of this character was a very grave one; failure meant a most serious blow to the finances and reputation, not alone of the inventors and engineers, but to everyone concerned in the erection and operation of the building.

It is fortunate that an unusual combination existed which made this venture possible. There was first a broadgauge and confident man who reposed implicit confidence in a Building Committee composed of men of daring and long experience, ably supported by an architect of exceptional mechanical knowledge and skill. Their decision was made after an investigation of two experimental machines, for they could be hardly considered more than that, which, while showing the vital elements of construction, were of only one-half the capacity required, and with many things ordinarily determined by time largely undetermined.

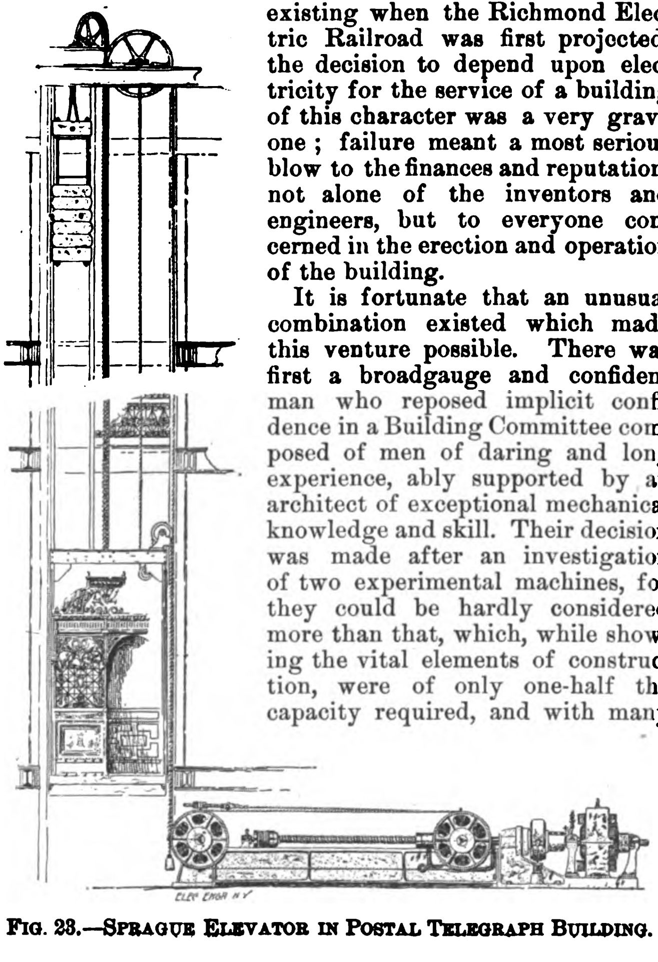


FIG. 23.—SPRAGUE ELEVATOR IN POSTAL TELEGRAPH BUILDING.

The plant as finally developed is also of interest as being practically the result of individual confidence, work and risk, on Mr. Sprague's part, during a time of grave financial depression, and when electrical enterprises were unfortunately under a cloud. The requirements and guarantees were, in brief, to duplicate first-class hydraulic service in speed, control, safety and capacity, to improve upon some of its characteristics, and to occupy less space. It was further promised that the cost of operation would not exceed one-half that of a corresponding hydraulic plant. In short, the issue was made in the broadest possible manner between the hydraulic and the electric elevator for the highest class of service.

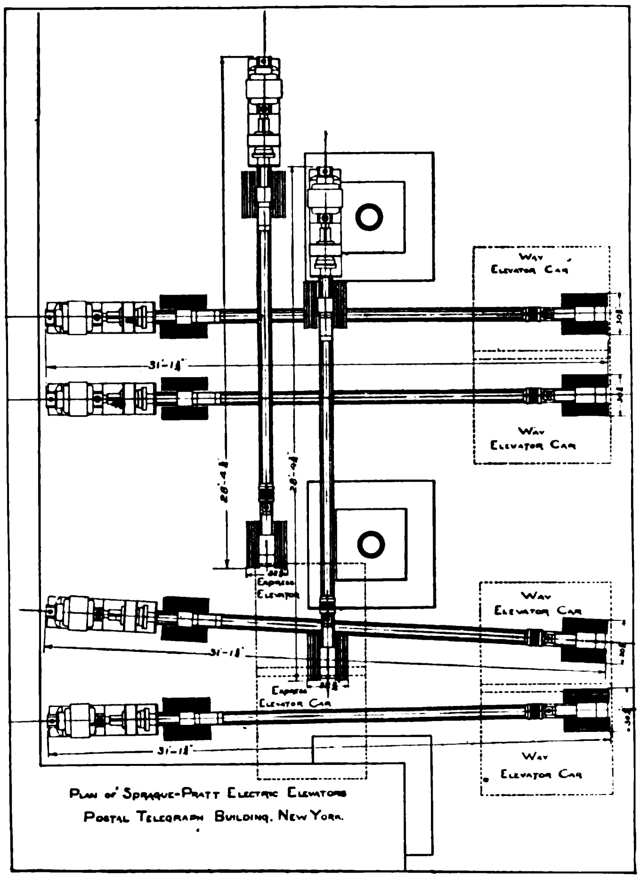


FIG. 24.—ARRANGEMENT OF FOUR WAY AND TWO EXPRESS MACHINES IN SUB-BASEMENT.

The problem was a hard one. Its solution has taken the most serious effort and represents the result of four years' incessant work, involving a radical departure from existing precedents and the solving of many novel mechanical and electrical problems. The result was shown in the letter accepting the plant, written after weeks of the severest sort of duty, with open and closed cars on freight and passenger service, carrying loads as high as 3,500 lbs., and under conditions taxing the operation of a machine to the utmost.

It seems to warrant Mr. Sprague's prediction that he would write the epitaph of the hydraulic elevator as that of the horse car had been written at Richmond, and the truth of the statement on the part of one of the Building Committee, that the signing of the Postal Telegraph contract *was* that epitaph.

XII.—THE SPRAGUE ELECTRIC PLANT IN DETAIL.

We will now describe in detail, as far as may be, the features of the plant which is to play so important a part in the future of the elevator industry, first giving a general description of the layouts, and then of the particular features of operation.

The elevators are divided into three groups, or pairs, two sets being "way" elevators, stopping at all floors excepting the 12th and 13th and arranged with one general frontage, a gang-way in the middle and the main stairs winding around one set. The remaining set constitute the "express" elevators, and stop only at and above the 11th floor, being practically private elevators for the Postal Telegraph and Commercial Cable offices, operating room and restaurant. This set is placed in the rear of one pair of way elevators and separated from them by the main stairs. All cars have independent platforms fitted with centrifugal governors set to be operated at 600 ft. car speed by standing ropes. The car finishes are of ornamental bronze of the usual type. The way cars are a fifth larger than the express and have four hoisting and two counterweight ropes, while the latter have two hoisting ropes less.

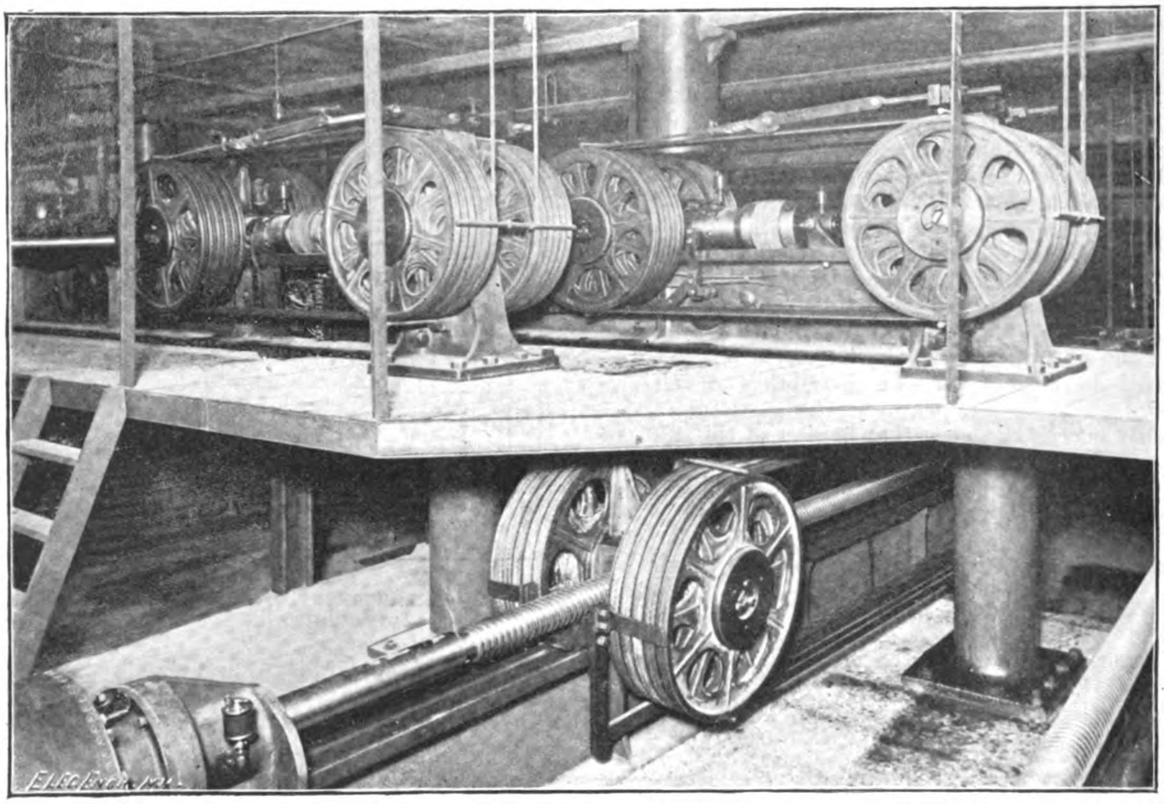


Fig. 25.—Fixed and Movable Sheaves of Express Machines, and Screw and Movable Sheaves of One Way Machine.

The required loads are directly, and the speeds inversely, proportional to the floor areas, those for the way cars being 2,400 lbs. live load at 325 ft., and for the express cars 2,000 lbs. at about 400 ft. The speeds running light are about 10 per cent. higher. These are the present normal speeds, but the motors have been found to be of such abundant capacity that the speeds can be increased to 450 ft. for the way and from 575 to 600 ft. for the express without difficulty or straining.

The shaft and overhead work is identically the same as in first-class hydraulic plants, and variable chain counterweights are used to make the pull equal at all points of the hoistway for any given car load. The lower landing is at the street level, with pit extending into the basement. The hoisting ropes lead directly to the outboard sheaves of the hoisting machines in the sub-basement and dividing on either side of the crosshead, pass around the sheaves, 10 geared for the way and 12 geared for the express, and are anchored to the head of the machines. So far, with the exception of the control, the practice is that of the horizontal hydraulic elevator.

Coming now to the machines in the basement, the distinguishing features of the electric plant become pronounced, and first, and by no means the least important, is the space occupied; for here, on account of the peculiar disposition of the cars and the position of the foundations and the party wall, six machines, two at right angles and above the other two, are placed in a space about 30 feet square, with ample room for at least eight more machines, all self contained, each perfectly independent, and with every facility of access and for renewal of any part.

Briefly described, the machine is of the horizontal multiple sheave type with a traveling crosshead and frictionless nut driven by a screw revolved by a motor directly connected and governed by a pilot motor and rheostat.

A reference to the elevation, Fig. 27, will show the general mechanical construction. This consists of a heavy main beam carrying the traveling crosshead and lower screw bearing, with special castings bolted at each end, one carrying the fixed set of sheaves and the other the thrust bearing, brake and motor. The regulating apparatus is independent and self contained and is placed on the wall. From the car to the system of multiplying sheaves this machine and the horizontal hydraulic elevator are practically the same. The crosshead, however, marks the point of departure in the two types, and this is the one at which the troubles of the hydraulic elevator begin, and also the one from which the Sprague-Pratt electric elevator marks its evolution in elevator practice.

In the hydraulic machine this crosshead is rigidly attached to the end of a rod terminating in a piston moving in a cylinder having an inside length equal to the lineal movement of the crosshead. This cylinder in the vertical type of hydraulics varies from 30 to 45 feet in length with from 2 to 8 sheave multiplications, and in the horizontal types the multiplication runs as high as 12 with corresponding diminution of length of cylinder and increase in cross section. Whatever the gearing, however, the length of cylinder is a function of the car travel. In this electric elevator, the crosshead being moved along a screw stationary so far as lineal movement is concerned, there is, with any given number of sheaves, only one variable, the length of screw, and, for all heights above about 90 feet, the electric machine has an advantage in matter of length which, with increased rises, becomes of great importance.

Turning now to the operation of this machine, there are four features claiming special attention, each unique in character and marking a radical departure from all other elevator practice. These are the nut, screw and bearing, the brake, the motor and the regulating apparatus.

The hoisting nut being the first step in order, its connection with the traveling sheaves is the first thing to consider. Fig. 26, shows the nut pointing in the opposite direction from that shown in Fig. 27. It will be seen, however, that it joins the crosshead of the traveling sheaves by a conical seat. There is no fastening between the nut and the crosshead, the continual weight of the car always keeping them in contact, and the friction at this point being greater than between the nut and the screw enables the latter to transmit a straight line movement to the crosshead when the screw is revolved by the motor, and also to revolve the screw and drive the motor as a dynamo when the mechanical brake releases the screw to allow the car to descend. These are the normal functions of hoisting and lowering. There are several other distinct functions of this nut which will be described under the head of "safeties."

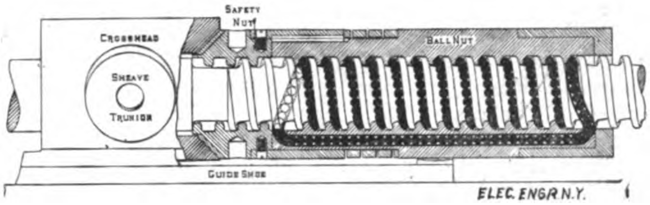


FIG. 26.—ELEVATION OF CROSS HEAD AND CROSS SECTION OF SAFETY AND BALL NUT.

To continue the line of transmission of power, it will be seen by Fig. 26, that the only points of contact between the nut and screw are by a chain of balls which occupy twelve threads, and are shown entering and leaving the ends of the nut through a tube which takes the balls as they leave one end and returns them to the other end at a tangent to the line of travel between the threads of nut and screw. This is one of the most vital points of the elevator apparatus, and herein lies one of the most potent reasons of its success, the reduction of friction by rolling instead of sliding surfaces on almost all parts under pressure; for, not only is the nut so constituted, being in fact a developed spiral thrust bearing, but the thrust bearing at the motor end of the screw is taken on balls and the sheaves are carried on ball or roller bearings.

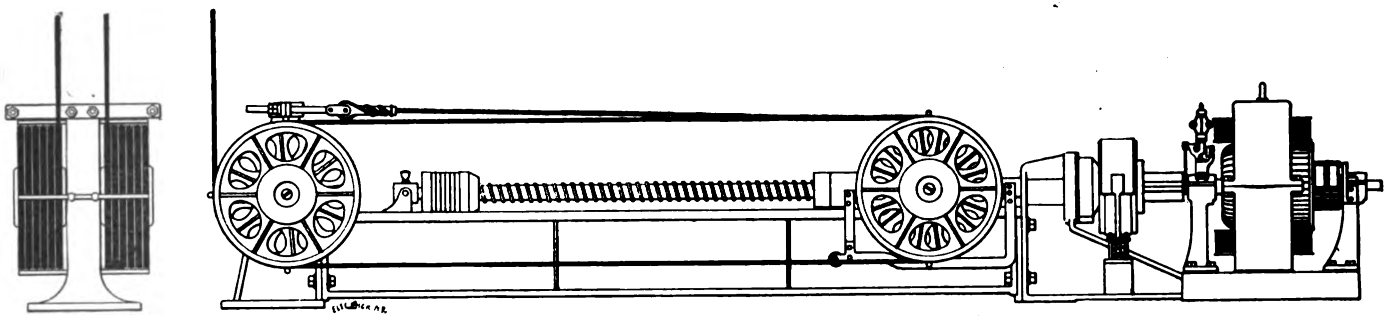


FIG. 27.—END AND SIDE ELEVATIONS OF SPRAGUE ELEVATORS IN POSTAL TELEGRAPH BUILDING.

All those who are familiar with the earlier operation of ball bearings are aware that there are many difficulties to overcome, and these difficulties are such as to lead many people to generally condemn them for heavy work and high speeds, notwithstanding the freedom from friction. It is unnecessary to enter here into the reasons for the many failures, or to explain how difficulties have been overcome in this machine, for these are in the nature of trade secrets. That the difficulties were many is apparent when it is stated that it took over a year to learn how to make the ball nut itself, nearly three years to bring it to perfection; and the mechanical features now characterizing it and the physical treatment of the metal itself are as essential as putting the eye into the point of a needle for a sewing machine. There seems to be no other way of getting at the result required except by the methods adopted.

This accounts for the opinion freely expressed by some of the best known manufacturers and experts some time ago that this nut was an impossibility. But this is not the first instance of an "impossibility" becoming a possibility, and the practical operation of the nut speaks for itself, as well as the fact that there is practically no wear on it, the metal at the surface and for some distance below being glass hard. So free is this machine from static friction that it is possible to start the car with a very slight increase of current over the normal hoisting current, provided time be taken so that the work done in acceleration is small compared to the work of lifting.

A test was recently made on a Fairbanks testing machine in New York to determine the liability of balls crushing under normal or extra working strain, and to settle once for all any doubt as to their ability to stand the duty required of them. Ten balls of two different makes were put under crushing strains, and required from 20,000 to 40,000 pounds to break each of them. Since the working pressure varies from 50 to 125 pounds per ball, there would seem to be margin enough to satisfy the most exacting.

The nut system is a compound one, for, besides the working ball nut there is another, called the safety nut, keyed to it, and between the two is a powerful spring under compression. The operation of this latter nut will be described under the "safeties."

The screw is a specially forged bar of high carbon steel with a peculiarly shaped thread. It passes through the clearance hole in the steel trunnion crosshead which carries the traveling sheaves, then through the nut system, and is carried at the outer end by a pivoted bearing. At the inboard end it terminates in the thrust bearing where the pressure is taken by about 220 steel balls carried in a bronze guide plate and bearing on specially hardened steel discs. The thrust of the screw being thus taken up on the inboard end, the strain on the screw is invariably between that end and the traveling crosshead, never beyond this; hence, it is always under extension strain, never under compression.

Beyond the thrust plates is keyed a radially lagged iron and wooden pulley connected by a flexible coupling with the motor shaft. The function of the brake is that of locking the screw when at rest, and is not a means of varying the speed. In case of accident it has the additional function of helping to stop the screw. It may be described as a compound electro-mechanical brake. The brake band, of steel, and leather lined, is anchored at one end, the hoisting side, on the motor bed frame, and the other end is continually pulled down by a powerful spring under compression. The mechanical movement in opposition is through the medium of a lever fulcrumed on a peculiar magnet casting and having at its short arm end a universal socket connection to the divided core of a closed circuit steel magnet. This core has a movement of $\frac{1}{8}$th of an inch, and with the expenditure of a quarter of a horse-power of electric energy has a pull of nearly three-quarters of a ton. It is operated by a dual circuit, one in hoisting, another in lowering, each possessing peculiarities in its action. In the event of failure of current for any reason, or too high a speed on the down run, this magnet releases the brake, in the latter case by a snap switch operated by a Pickering centrifugal governor driven by the main screw, and the brake band promptly grips the brake wheel softly, yet powerfully. The operation of the brake on the up and down movements is different, and the unexpected softness, yet power, of its action can only be appreciated and understood by an inspection and a further knowledge of a unique electrical action not here described.

XIII.—THE MOTORS AND REGULATORS ON THE SPRAGUE ELEVATORS.

The motor, Fig. 28, is of the 4-pole type, two poles being consequent, and the winding is strongly compounded. The field magnets are of a special grade of steel. The direction of current in the field coils and armature is never reversed, and the machine is never demagnetized, because, in hoisting, the line E. M. F. predominates, while in lowering, the reversed E. M. F. of the motor is the only active one in the armature circuit. It should be remembered that this type of elevators is differentiated from all other electrics in that, like the hydraulic, it always works against gravity; the motor takes current from the line in hoisting, but in lowering it is cut off from the line and is operated as a driven dynamo by the falling weight of the car.

The armature is iron clad, is of the two path special slotted drum construction, has one turn of wire to each coil, and each turn is securely imbedded in an independent insulating tube rigidly held. The carbon brushes are double, have independent movement, and ample capacity to carry the full current without flashing. The neutral point is fixed. The machine is self-oiling and the bearings are independent of the field castings.

The last individual feature of the machine to be considered is the regulator and the method of operating it. This apparatus which is shown in Fig. 29, is an independent one and connected to the hoisting machine only by the wires necessary for the circuits. It is, in brief, an open cast iron frame carrying inside a slate disc having on the lower side a row of bronze contact clips, and on the other, attached to these clips and to each other by tap screws, a series of grids arranged in a circle. These grids are peculiar and mark an important advance in rheostat construction. They are about 9 inches long, 4 inches wide and $\frac{3}{8}$ of an inch thick, and are cast in a form somewhat resembling a ribbon folded on itself. They are freely flexible when taken separately, although iron is one of the principal ingredients. The exact composition is not made public, but it is such that the resistance averages about fifty times that of copper. The grids can stand a very high current and the temperature co-efficient, while not constant, is sufficiently small not to be objectionable.

On top of the frame is carried a $\frac{1}{4}$ h. p. motor connected to the car switch through a pilot board by a cable of four insulated wires, which operates the rheostat and circuit changers. The motor is coupled to a worm gear which carries a small pinion meshing into a spur gear on the circuit changer and controlling cylinder. This cylinder has a bevel gear driving a pinion on top of a vertical shaft, at the lower end of which is the rheostat brush arm. This brush arm carries carbon brushes which bear on the bronze clips. There are 120 of these, and the difference of potential between them is too small to cause any sparking. A quick-acting circuit breaker prevents arcing at the first clip.

The operator in the car has it within his power to put the brush at any point of its travel and leave it there as long as necessary. The same rheostat is used in hoisting and lowering and the arm travels over the whole range of clips in either movement. This operation is controlled electrically either from the car or from the pilot controlling switchboard in the engine room.

In hoisting, as seen from the car, the operator moves a small lever and the car starts with a perfectly accelerating speed, no jerks or pulsations being felt. Ordinarily he puts the car to full speed and makes his stop exactly at the landing with one motion of the switch. If, however, he stops a short distance below the landing floor he can raise the car that distance as in a hydraulic elevator. The operator can regulate his speed from slow to full speed, which last may be as high as 600 feet per minute. A small rheostat in the field of the hoisting motor gives a fixed adjustment of about 10 per cent. variation in the maximum speed of the car. If the operator forgets or is unable to operate his switch to stop the car, there are two automatic stops which will only allow it to go a few feet above the top floor.

The moving of the switch to "up" puts current through the up coil of the pilot motor, which, moving the regulator, connects the main motor to line, sends current through the armature and a progressively reduced resistance, the current releasing the brake and increasing the torque until the armature begins to turn without shock or jar, and thus accelerates the car in a perfectly timed progression. A return of the switch to "steady" instantly arrests the movement of the rheostat arm, checks the pilot motor by an automatic brake and stops the acceleration of car speed. A return to "stop" cuts off the current gradually but more promptly than the reverse movement is made.

In lowering, the rheostat brush closes circuit on the zero resistance clip, and at the same time closes a circuit through a shunt coil on the brake magnet, releasing the brake. The motor now becomes a separately excited compound dynamo with the weight of the car to drive it.

There is no effort of the motor exerted to aid the car in lowering. The friction for the weight of the car to overcome in order to start this dynamo load consists of that of the car guides, overhead sheaves, multiplying sheaves, the crosshead guide, the ball bearing nut, the thrust bearing of the screw, and all the screw and armature bearings. The fact that 500 lbs. on the hoisting ropes will overcome this and start the motor instantly, is due to the use of rolling friction on all sheaves, the nut, and the screw thrust bearing.

It is impossible to attain a rapid acceleration of speed on the start down, for at the first position of the rheostat brush the torsional resistance of the armature will not allow the full car load to drive it above 5 per cent. of its normal speed, and from there to the highest resistance there are 120 variations of speed up to the maximum. Aside from this, the mechanical conditions of starting a screw to revolve by pressure on the nut from a limited force when the pitch is slight and the inertia of the armature is considerable, renders a sudden start impossible and insures an even acceleration of speed independent of the dynamo action. When the car is within about six feet of the lower landing a roll on the traveling sheaves engages a lever that reduces the resistance in a by-path in the armature circuit and brings the car to an easy stop at the landing independent of the operator.

Besides the control from the car there is provided in the basement an unique general controlling switchboard by means of which the control can be taken from the switch in any car and transferred to the switch on this board. In this way general inspection, cleaning, testing, or if needed, replacement of any part of the regulator or machine, whether in the ordinary course of affairs, or in case of accident, the hoisting of safes,—all can be carried on from below without an operator in the car; in fact, even while in motion the control can be instantly taken from the operator and the car run from the pilot board.

The care and attention required by an elevator of this type as compared with the hydraulic plant is in its favor, for aside from the ball bearing nut there are no more parts to attend to and renew than there are in an ordinary electric elevator. The thread of the nut is hardened by a special process that renders it for a depth of ¼ of an inch as hard as steel can possibly be made. The thread is afterwards ground true and smooth. Tubes are then inserted to circulate the balls from one end to the other. The balls are one-half inch in diameter and of standard make. The load per ball is not over 100 lbs. maximum.

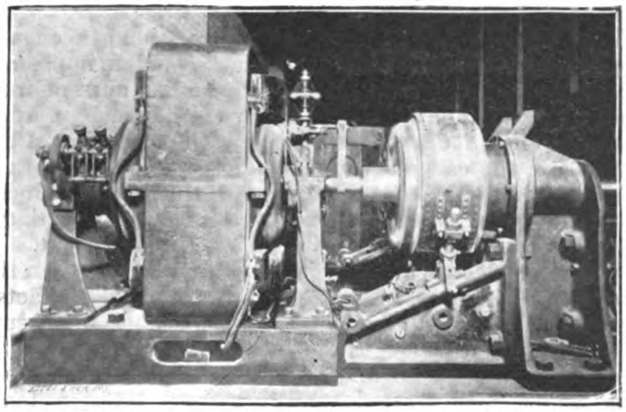


FIG. 28.—MOTOR END, SHOWING CENTRIFUGAL GOVERNOR, BRAKE, AND THRUST BEARING STAND.

One of these nuts has run for 24 hours a day, for 16 months, and was only removed twice in that time for inspection. The operating nuts of the Postal Telegraph plant, although at times under vicious duty, show no wear of the working thread. As illustrating the facility of access, a car can be slung by its ropes from below, the end screw bearing, the buffer nut, the working nut all removed, the balls taken out and inspected, the nut cleaned, and the whole restored and car put into operation again within thirty minutes. The balls in the nut can be inspected while the machine is in operation.

The multiplying sheaves run on bearings which show no wear at all and do not require oiling or cleaning more than once a year. Not a drop of oil runs out of them. Hydraulic engineers will appreciate this, and also the fact that any or all sheaves on this elevator can be removed without disturbing any other part of the machine. There are four nests of sheaves on each elevator and any nest can be exchanged for a spare nest within five minutes after the ropes are slacked. It would take five hours to do this on a hydraulic elevator, as it would be necessary nearly to dismantle the whole machine to get at them. The Sprague-Pratt machine can be absolutely dismantled and practically every working part laid on the floor in an hour and a half.

XIV.—THE "SAFETIES" ON THE SPRAGUE POSTAL ELEVATORS.

We now come to the vitally important element of "*safeties.*" In this connection we will consider the hoisting machine apart from all electric and other safety devices. First, the screw : This is a bar of special forged steel under tension and torsion strains, and capable of sustaining twenty times the heaviest load applied to it. Second, the hoisting nut : This is of special steel hardened and finished by a special process, and has shown almost no wear whatever in a year's severe run under conditions particularly onerous.

In addition to this is a safety nut. This nut is normally out of contact with the screw's thread ; it is secured to the hoisting nut, and should any accident happen to the latter which would break its hold on the screw's thread, this safety nut, the thread of which interlocks with the screw's thread to a greater depth than the thread of the hoisting nut, would then take the place of the hoisting nut and form an anchorage to hold the traveling sheaves with a grip exceeding the strength of the screw. This would put the elevator out of operation, as the friction between this nut and the screw is greater than the friction caused by the pressure of the traveling sheave crosshead against it ; this nut would then act simply as a collar on the screw, and, revolving the screw, would transmit no motion to the car. It is obvious that the only parts of this elevator that could wear out so as to allow the car to fall if there were no safety nut, are the threads of the hoisting nut or screw. Therefore having a safety nut which is subject to no wear and the thread of which reaches nearer the centre of the screw than does the thread of the ball nut, a condition of safety is reached which is independent of the wearing out of the machine and also independent of any automatic safety devices. But it may be remarked that special processes of manufacture, amply tested by severe duty, insure an exceedingly low rate of depreciation on the ball nut and screw.

There is another safety in the nut system, however, warranting special mention. As before stated, the hoisting nut is only held from revolving by its friction against the crosshead; when the nut gets to the upper limit of its travel the safety nut meets a solid collar on the screw which stops its travel and causes it and the ball bearing nut to revolve with the screw, thus stopping the travel of the nut absolutely without stopping the motor, and allowing the traveling sheaves to be stopped simply by the weight of the car. This stop has been made at full speed without any injury whatever. Of course this never works when the upper limit switch is in proper order, and there is nothing about this last to get out of order. Hydraulic elevators have been known to knock out their cylinder heads or otherwise wreck themselves when their upper limit valve failed to work.

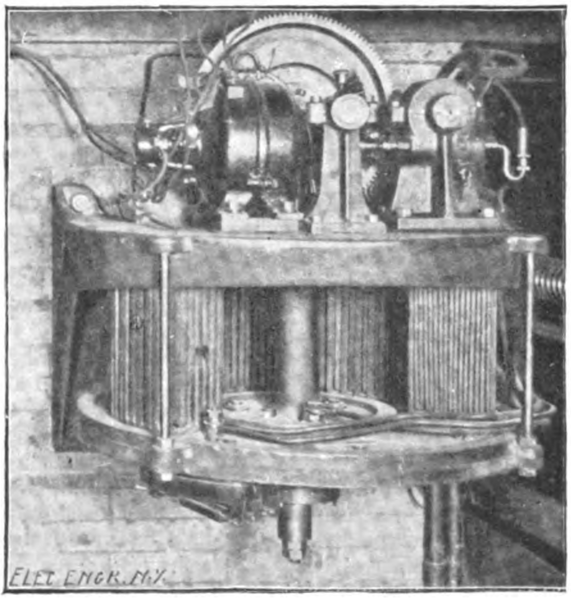


FIG. 29.—RHEOSTAT, PILOT MOTOR, AND CONTROLLING CYLINDER FOR ELEVATORS.

Another important function performed by the hoisting nut in a very simple and direct way is its action as a slack cable device, and there is no more dangerous annoyance common to all rope elevators than the paying out of slack cable when the car is stopped by some obstruction in its path while descending. The usual result is either that the obstruction gives way and the car falls to the extent the cables have paid out and perhaps breaks them by the shock; or else the operator starts to hoist the car after the cables have slipped off of the sheaves or winding drum and in so-doing cuts and kinks the cables into a useless condition. This is liable to happen to any horizontal hydraulic elevator.

With the ball bearing hoisting nut the result is very different, the action being as follows: The car descending at high speed and driving the nut along the screw, revolving the screw and armature thereby, meets an obstruction, the pressure against the nut is reduced to only that given by the weight and sag of the ropes, and the working nut recedes slightly which allows the spiral spring between the safety and ball bearing nuts to extend and force the safety nut against the back of the screw's thread. The friction then between the nuts and the screw is greater than between the safety nut and the crosshead; therefore the hoisting nut at once revolves with the screw, its travel along the screw ceases, and it checks the travel of the traveling sheaves before the cables are really slack. This action has been tested with a car stopped by its centrifugals when going 600 feet per minute.

It is moreover evident that if the screw should become free to revolve unchecked by motor or brake, an improbable contingency under normal conditions, the weight of the car would not cause the screw to revolve at a speed at all comparable to a free fall. In any event there remains the rubber buffer at the lower end of the screw to cushion the end of such a run. The use of the buffer as well as the frictionless character of the nut have been most effectively illustrated by actual drops from heights up to the 12th story. This buffer nut can stop a car going at a speed of 800 feet per minute in 18 inches without starting a bolt or fastening.

Assuming then that the car is perfectly safe for any load that it will be called upon to carry, it only remains to establish an absolutely safe connection between the hoisting machine and the car. Experience has shown that owing to the size and number of hoisting ropes used on passenger elevators and the care that is taken of them there has never been an accident due to the actual breaking (other than at fastenings) of the ropes on passenger elevators. Ropes, however, have been known to pull out, or break away from their fastenings. This, therefore, is the last point necessary to establish the fact that this elevator is absolutely safe.

The rope fasteners used on the Sprague-Pratt elevator consist of a solid body of metal which has a double spiral groove; the ropes enter this groove by being passed through a loop in one end, wound twice in one groove, passed through a loop in the other end, returned in the other groove in spiral convolutions between the first winding and out through the loop in the first end. This engages about three feet of the rope, instead of about three inches which other rope fasteners hold. There is but one way a rope can be put in this fastening, and it will hold almost any size rope equally well. Tested in a Fairbanks testing scales, it took 10,500 lbs. to break a five-eights inch iron wire rope, which gives this rope a higher rating than quoted by the makers in their catalogues. The engineer in charge of these scales stated that other rope fasteners usually break the rope at from one-half to three-fourths of the rated strength.

Besides the lower limit switch already described, there is an upper limit switch for cutting off the current. This is a double operating and self-cleaning lock snap switch moved by a roll on the crosshead, and cuts off the current in hoisting at the upper limit, allowing the brake to come on. On the reverse movement the circuit is closed for hoisting.

The centrifugal on the machine for operating the brake when running down too fast has already been mentioned. In hydraulic elevators there is no speed regulating device in case of running too fast except the centrifugal on the car, and usually this is set so high on account of the annoyance with having it operated with temporary excess of speed as oftentimes to be useless when actually required. Another centrifugal is used on this electric machine which is additional to that on the car and this is set to operate at a small excess above the allowed speed. It does not interfere with the operation of the car centrifugals but simply puts the brake on the machine in case of limited excess of speed and is ready for use again as soon as slowed down, instead of being tied up, as is the case when a car safety works.

We now come to the all important question of economy, and here, too, this electric elevator has scored an important victory over the hydraulic, for while buying current from the street system at the rate of five cents per h. p. hour, reckoned on an 850 watt rate, pending the operation of the local plant, the cars have been operated at a cost not exceeding three-fifths of a cent per round trip of 26 floors, which is less than 40 per cent. of the cost of operating a like hydraulic system even with an independent plant.

Why this electric elevator is more economical than the hydraulic can be easily seen from the following facts: The standard hydraulic elevator as now operated is supplied at a practically constant pressure by a compression tank automatically regulated in the basement, or a roof tank which may have in addition a compression tank. Whatever the load, identically the same amount of water at the same pressure is used for every foot of travel and consequently no matter how light the car may be running, it always uses the maximum power. Statistics taken time and again prove that the average live load on a passenger car is not over one-fifth the maximum which it can carry. Including the counter-weight, which in a high speed hydraulic elevator is, on account of the friction, fully 400 pounds lighter than in an electric elevator of equal capacity, on account of the difference of friction, the total average load is about a third of the maximum.

For an example: Take a car of 30 square feet floor space. This can be loaded up to about 100 pounds per square foot or 3,000 pounds live load, while the average live load will not be over 600 pounds. In a hydraulic elevator it would take about 900 pounds excess of weight in car over the counterbalance to insure proper running. This means a load of 3,900 pounds on the ropes. But this is not all. Since the speed of the car with any given opening of the valve is a function of the difference in pressure in the supply and the cylinder, and since there must be an excess of pressure on the supply side in order to have the car move at all, then to move this total load of 3,900 pounds at even a low speed there must be a capacity to actually lift about 500 pounds more than this, or 4,400 pounds; yet the average load on the ropes is only 1,500 pounds.

In a Sprague-Pratt electric elevator such a car can be operated with 600 pounds excess of weight, making an average load on the hoisting ropes of 1,200 pounds, and since this elevator uses power very nearly in proportion to the load over friction we would have as between the two classes of elevators a constant duty on the hoisting ropes of the hydraulic of 4,400 pounds, and on the electric of 1,200 pounds. Here then is a difference of nearly four to one in favor of the electric, considering solely the question of work actually done on the hoisting ropes. Without going into exact statements the friction of the electric machine is quite as low as, if not lower than, that of the hydraulic, because one is on ball bearings, and the other has a tightly packed gland and piston.

Going back now to the generation of power, the best pumps in common use require 70 to 85 lbs. of water per horse power delivered to the water column, whereas electric power can be delivered to the mains of the motor for an expenditure of about 35 lbs. of water. It was well known before this Postal elevator plant was started that the economy indicated would be shown, but it has been some satisfaction to have it demonstrated in so emphatic a manner by a long period of operation. In view of what has already been accomplished, the future of this system as a controlling factor in the elevator industry will be of interest.

XV.—THE WESTINGHOUSE ELECTRIC GENERATING PLANT.

It has already been intimated in an earlier section of this article that dynamo current is the source of supply for the telegraphic circuits, batteries being entirely supplanted by dynamotors. It has also been shown that the building has six large electric elevators. As the same generating plant has to furnish current to these two highly important services as well as to operate the whole electric lighting plant of the building, with not a little incidental motor service, it will be seen that its function in the Postal Building is far more vital than falls to the lot of the usual dynamo system. Evidently the apparatus must be of the very best, with liberal margins of safety factors, and must be installed in the best manner known to the art. In the present case, after a most careful investigation, accompanied by inspection of plants in various places, the contract was awarded to the Westinghouse Electric & Manufacturing Co., and a request was made by the Postal Co. that Mr. E. W. Seymour should be appointed the Westinghouse representative to direct the installation throughout. As a result of this admirable choice, all the arrangements for this very interesting plant were made by Mr. Seymour, with all the complex details of interlapping circuits, switchboard combinations, etc. During the last six months, Mr. Seymour has given at least half his time to the work in the building, and both parties to the contract are to be congratulated on the creation of one of the most perfect and flexible isolated plants ever installed.

The Westinghouse Electric & Mfg. Co. does not execute any construction work, but in this case undertook the whole contract and made approved arrangements with Mr. Paul Lemaire, the well-known contractor, for the electrical details, wiring, etc., and with Westinghouse, Church, Kerr & Co. for the steam construction. The plant, Fig. 30, consists of five Kodak units, with space provided for a sixth. It is set as a whole on one solid block of concrete 100 feet long, 20 feet wide and about 8 feet deep, absolutely insulated from all the building foundations by a space varying from 12 inches to 3 feet. There are two Westinghouse compound engines, 160 h. p. each, 13 by 22 by 13, and three 100 h. p. each, 11 by 19 by 11, the larger making 240 r. p. m. and the smaller 290. Their ratings are guaranteed at 125 pounds pressure. Directly coupled to these engines are two 120 kilowatt Westinghouse compound wound multipolar generators, running at 240 volts, and three of 75 k. w. capacity each, at 125 volts. The plant is practically in duplicate. The two large machines are for the electric elevator service. The others are for the lighting, telegraph work, etc., guaranteed at constant speed, to generate a voltage of 110 v. minimum or 130 v. maximum, and to maintain 10 lamps to the delivered horse-power. The other conditions are of like order. The machines are all arranged to feed to one set of bus bars on the main switchboard, whence the current is distributed for all the various low volt services. The trough-like space around the foundations is utilized in front for the steam and exhaust pipes and in the rear for the cables carrying current from the dynamos, through 2-inch iron ducts. The current from each generator is transferred to the back of the switchboard by eight No. 0000 stranded, lead covered Safety cables, without splice,—four in each leg,—and all out of sight. At the rear of the plant, on the side walls, are two equalizing terminal boards, the first providing for the two power generators and the second for the three lighting generators. Each set of machines is permanently connected, through its corresponding equalizing main, so that the fields are always charged. The machines are protected by double break carbon point switches on each machine, and with automatic circuit breakers at the cable terminals on the main switchboard. Additional to the cables from the existing machines to the switchboard

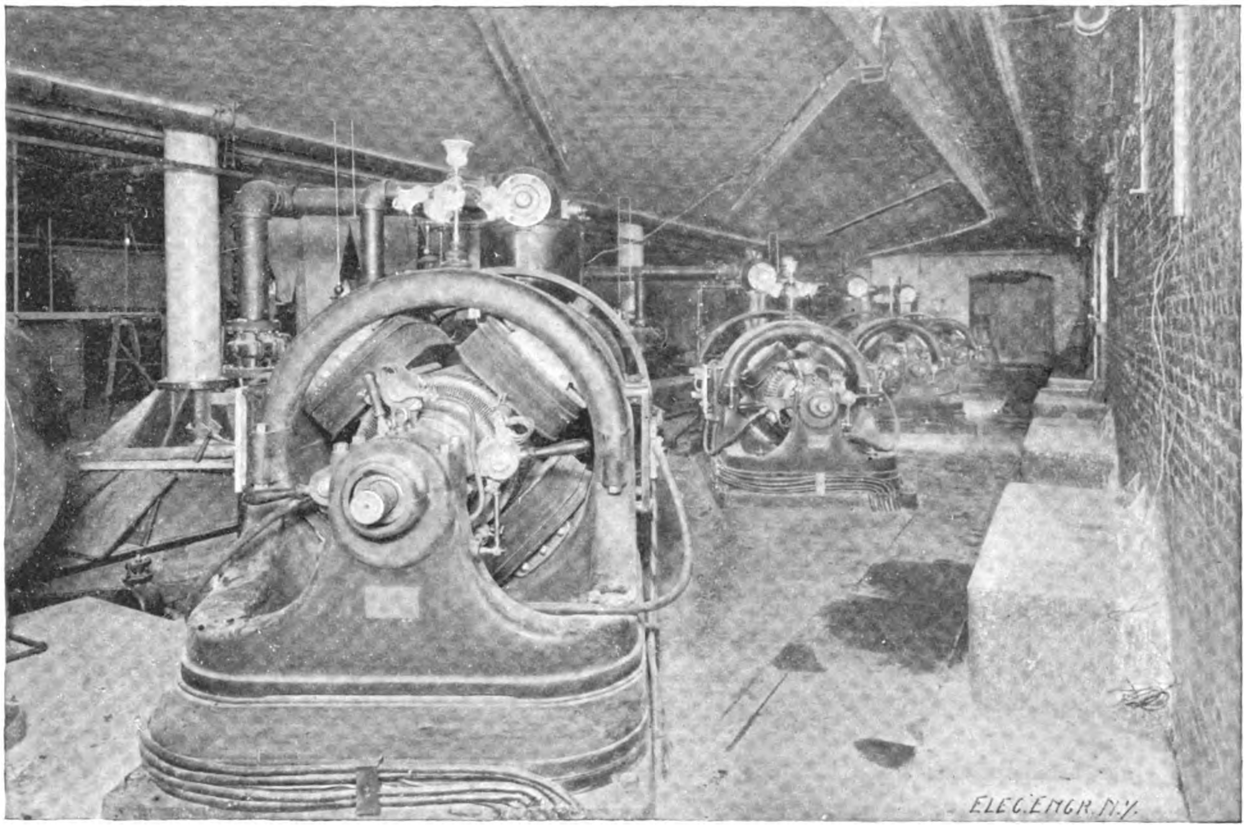


FIG. 30.—WESTINGHOUSE DYNAMO AND ENGINE PLANT, POSTAL TELEGRAPH BUILDING.

are a proportionate number of extra ones for the sixth machine contemplated, and three more cables for the transference of Edison street current to the section of the board provided for such use.

XVI.—THE MAIN GENERATING SWITCHBOARD.

In the centre of the dynamo room stands a very handsome main switchboard, Fig. 31, built by the Penrhyn Slate Co., of marbleized slate. It is 30 feet long, 10 ft. 6 in. high and 1½ inch thick. It is mounted in brass and bound by a massive brass frame. It is erected in 12 sections and in reality comprises four distinct boards. The right hand end nearest Broadway and the Crocker-Wheeler dynamotor plant is reserved for telegraphic work. The middle section with two side wings is allotted to the lighting plant proper. The section to the left of that is devoted to the Sprague elevator plant, and the outer, west end, section provides for the Edison street service and various combinations to be effected between the different boards just enumerated. The whole board is supported from the ceiling and the floor and forms the front wall of a solid brick chamber 35 feet long, 12 feet 6 in. high and 6 feet wide, absolutely fireproof. All connections to the board are made behind it, in this space, by means of lugs carried through from the various instruments, and protected from leakage by having every hole reamed out large enough to admit of very heavy insulating bushings. The specification called for a difference of potential between generator terminals and board not to exceed 1 per cent.

The instruments mounted on the board, and presenting a magnificent appearance, are entirely of Westinghouse make, except the voltmeters and ammeters, which are made by the Weston Electrical Instrument Co. There are 5 controlling rheostats; 8 illuminated dial Weston ammeters; 7 illuminated dial Weston voltmeters; 2 Weston potential indicators; 5 double-pole main generator switches, 600 amp. capacity each; 5 automatic circuit breakers of 600 amp. capacity each; 18 d. p. 200 amp. jaw switches for proper control of lighting circuits; 21 d. p. 100 amp. and 7 100 amp. d. p. double throw switches for the control of the telegraph board; two 300 amp. single pole; one 600 amp. single pole; one 600 amp. triple pole; one 400 amp. d. p. and one 200 amp. d. p. double throw switches; two automatic circuit breakers, one of 300 amp. and one of 600 amp. capacity for the proper control of the Edison service and its combinations; and 18 circuit pilot lights crowning the board, fed from the centres of distribution to show the condition on all the corresponding circuits.

The central section of the board is also designed to show by main instruments the conditions of the different sections on either side of it, and is provided with a main ammeter totalizing all the subsidiary ones; a potential indicator for like service; a full chronometer clock built specially by Charles Korphage; a compound steam gauge; a compound vacuum gauge; an Edson recording gauge; voltmeters corresponding to the various lighting machines; and a ground detector common to the whole system. Hence it will be seen that the chief engineer has the whole working status of his plant under his eye from the boiler to the last lamp.

This board is indeed the heart of the building. Through it passes every particle of current upon which the various branches of telegraphy, lighting, motors, and elevator service depend. There are one or two important features in this respect still to be pointed out. The plant is so arranged that, as stated, it can be run in two sections, the 125 volt current taking care of telegraphy and lighting and the 240 volt of the elevators. But should occasion arise, a half minute's manipulation of the switches provided for such a purpose will transfer the whole system to the lighting generators alone, thus running the elevators at half speed. This has been done with a view also to late night work, when no little economy can be effected by carrying all the load on one unit at its capacity rather than on two or three large underworking machines; and when, the main building being empty, very few elevator trips will be made, chiefly for messengers or night staff.

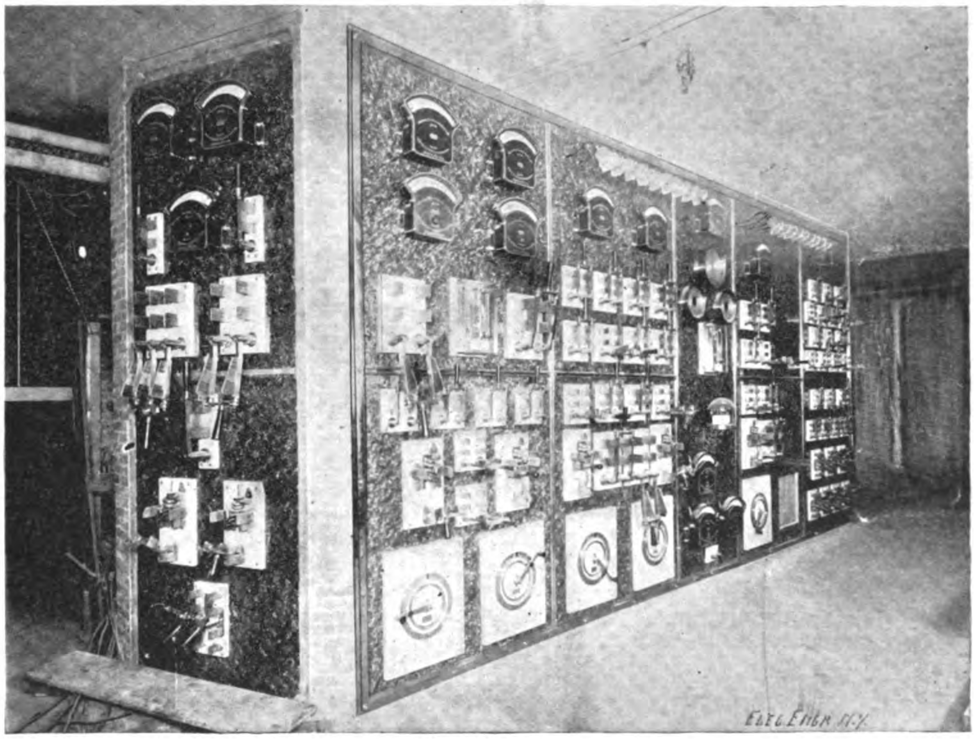


Fig. 31.—Main Electric Light and Power Switchboard, Postal Telegraph Building.

XVII.—PROVISION FOR UNINTERRUPTED CURRENT SUPPLY.

The board or section controlling the Edison street service is a most important adjunct in the item of continuity of operation of the telegraph system. With the plant originally provided and now installed, it would be next to impossible for all five units to break down at once. But the point was brought up that the city water supply might fail, and if it did so, only for a few minutes, the interruption would be a serious disaster for the telegraph service. The local Edison company, however, has a means of water supply quite independent of the city water mains, and a cutting off of the supply would not affect it. This being the case, it was decided by the officers of the Postal Company to re-inforce their system by having the Edison street current always at instant command; and thus a fifth section was provided in the main board. It provides for what we may call a "lightning transformation" of no little intricacy. First the entire building is cut off from the bus bars. Then 120 volt current is brought from outside to the lighting and telegraph board, and 240 volt to the power board, and the building is thrown on again. The switches are so constructed as to prevent the man in charge from crossing his voltages upon the same bus bars, and automatic locking devices are also provided by which it is rendered impossible to use any of the combination switches necessary to change the currents if the main switches of the regular plant are thrown. The device is mechanical and, so far as we are aware, is a new feature in such work. An additional protection is given by two circuit breakers, one for each leg of the 3-wire system The Edison board is also provided with separate instruments to indicate readings for quantity and potential when current from the street should happen to be in use.

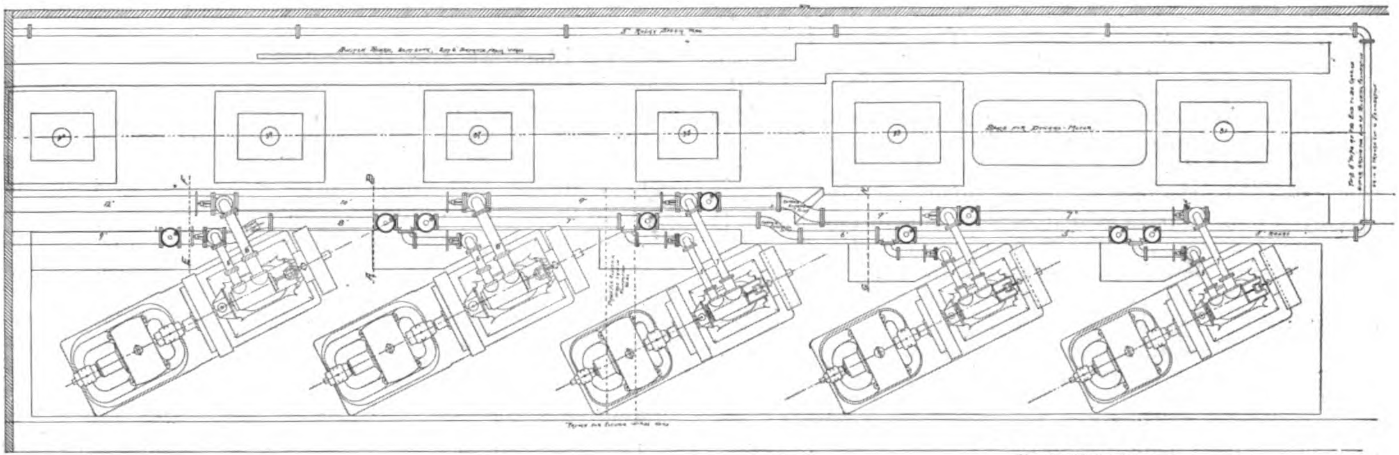


FIG. 32.—ARRANGEMENT OF WESTINGHOUSE DYNAMO AND ENGINE PLANT, POSTAL-TELEGRAPH BUILDING.

A feature of the rear construction of the whole board will be found in the use of four bus bars on the main lighting section. The first bus bar serves as a shunt bar, in which the main shunt is inserted and connected with the second bus bar; and the first bar supports the secondary shunts. This corresponds with an arrangement of instruments which permits a reading for every generator and for the summation shown on the main ammeter. The first, second and third bars might be called the positive bars, the second and third being connected together by switch manipulation when the two wire system is in use. The third bar is the negative, and all connections between the circuit switches and the bus bars are so made and balanced that the separation of the second and third bars will immediately so group all circuits as to admit of the use of the three wire system.

XVIII.—THE TELEGRAPH AND POWER BOARDS.

The telegraph board, or section, is provided with two bus bars, independent of the main board; and a shunt is inserted on the positive bar to admit of an individual reading on the ammeter of that board. About 200 amperes go through this board.

The power, or elevator, section of the main board is provided also with two bus bars, and is so laid out, as already described, as to admit of receiving current from its own special generators, from the lighting generators, or from the street mains. This board has two sets of ammeters and voltmeters, potential indicators and circuit breakers for the main generators; also six 100 amp. d. p. switches which connect the bus bars of the section directly to the six motors employed, one on each elevator in the Sprague elevator plant.

It may be added that there are over 60 cables of various sizes carried underground from the telegraph board to the board controlling the Crocker-Wheeler dynamotors.

XIX.—DISTRIBUTION THROUGH THE BUILDING.

A notable feature of the main switchboard is that it is built over a brick walled pit, some 30 feet in length, 2 feet wide and 2 feet deep. Into this pit all the underground cables already mentioned are conveyed through ducts and led up to their respective terminals on the board. But all the circuits leading to the different floors of the building come into the switchboard enclosure at the top, through the basement floor above, and are carried down to their respective terminals. Hence it has been rendered impossible for a feeding wire and a distributing wire to enter or extend in the same direction.

The lights originally contracted for by the Westinghouse Co. were 2,500, but this has been increased to 3,500 and the plant has an easy capacity of 3,600. The system of wiring is that of two separate mains for each floor in the building, carried directly from the switchboard to distributing terminal boxes on each floor, one set in the front of the building and one in the rear, known respectively as East and West mains. There are also two separate circuits for both sections of the building, for all the halls, toilet rooms, etc., independent of any other lighting. All this is under separate switch control. All cut-outs are mounted on non combustible bases, and are double pole. Each lamp is allowed .6 ampere and the loss to each lamp does not exceed 5 per cent. while that on any branch circuit is not 2 per cent. Before leaving this part of the plant, it should be added that by means of the two terminal distributing boxes on each floor, test of any individual circuit is made without disturbance to any other, while current can at once be cut off any East or West section. Moreover, as an element of satisfactory control, the instruments are always in connection with the machines, ammeters and voltmeters being always in circuit. The illuminated dials show at once what machines are in use, as well as the pilot lights; and the automatic locking devices already referred to are reinforced by a system of danger signal red lights placed right under the handles of the main and combination switches, so that their intimation will in itself safeguard the whole service. In fact, not a single feature of precaution has been neglected; on the contrary, the lavish resort to every possible countercheck, duplication and control is the thing that most impresses the observer in this beautiful triumph of electrical engineering.

XX.—BOILERS, PUMPS, ETC.

The boilers, Fig. 33, are in three batteries of two boilers of 150 h. p. each, furnished by the Babcock & Wilcox Co. and installed by J. S. Haley & Co., steam fitters, etc. Steam is carried from them to the engines by the piping indicated in our diagram of the dynamo room. Coal is transported from the sidewalk bunkers to the furnaces by means of a light Hunt truck and narrow gauge track. In an adjoining room, Fig. 34, is an adequate complement of Worthington pumps, with a Blake pump or compressor for the Miles pneumatic tube service. Everything is solidly installed, with ample elbow room. It should be mentioned that in order to provide against a break in the water supply, a reserve tank adequate to carry the power plant for 48 hours has been laid in concrete directly under the floor of the pump room.

XXI.—WIRING, FIXTURES, ARC LIGHTING, ETC.

Incidental reference has been made to wiring, fixtures, etc., and it has been stated that this was in the hands of Mr. Paul Lemaire, to whom all such contracts were entrusted by the Postal Co., the Westinghouse Co., the Sprague Co., etc., and of whose anxious care every part of the work gives abundant proof. The Safety Insulated Wire and Cable Co., of this city, supplied all the wire and cable, in accordance with the Postal specifications, and the use of the No. 0000 cable has been described. Besides these, Mr. Lemaire used 8,000 feet of No. 000 to No. 00 of Safety cable for the feeders. For the wiring through the building the Safety Co. furnished him with a special braided wire, of which he used 150,000 feet in No. 12 and No. 14 sizes. All this wire runs in Vulca duct furnished by the New York Insulated Wire Co. Mr. Lemaire had also to provide in each office through the building an outlet for a 10-conductor cable for the miscellaneous services of telephone, district messenger, etc., and for this 7000 feet of brass armored conduit was supplied by the Interior Conduit & Insulation Co. For all this work Mr. Lemaire prepared a minutely detailed set of plans, locating every outlet and every light. Another feature of Mr. Lemaire's work is the use of his new arc lamp for incandescent circuits, of which the Postal Building has some 60 in use, 16 being located in the operating room and 16 in the ground floor receiving department. These lamps, which feed on a very slight variation in the length of arc, give a soft, very steady white light, and their effect in the big operating department is most pleasing as they supplement from above the incandescents on the octet tables, and kill all shadows without any drawback in the nature of glare, etc.

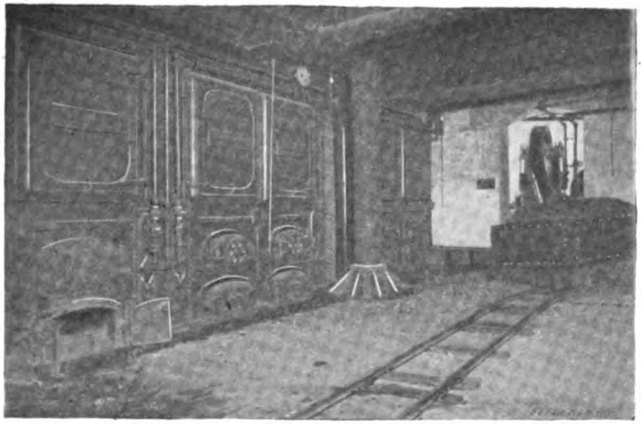


FIG. 33.—BOILER ROOM IN SUB-BASEMENT.

The fixtures for the building were supplied by the Central Gas & Electric Fixture Co. of this city, represented by Mr. C. E. Perring. We illustrate at the introduction to this article, the huge exterior flambeaux, in the form of the caduceus of Mercury, each 16 feet long, with a cluster of incandescents enclosed in a globe, on one of which the Commercial Co.'s "trade mark," and on the other that of the Postal Co., is represented; and we illustrate also the central chandelier of which some 500 are used in the offices all through the building. The brass work is in the shape of cable, at the bared ends of which wires can be seen. Besides these chandeliers, there are about 800 brackets of the same general design, and in the hallways there are 40 very odd fixtures suggesting the same idea. The Lemaire arc lamps in the operating room are ornamented in an elaborate manner in real bronze, so that the framework is entirely disguised. The Hardware Club, on the roof floor, has also put in some beautiful special fixtures of Flemish design. It is also worth noting that all the door handles through the building have the Commercial globe on them.

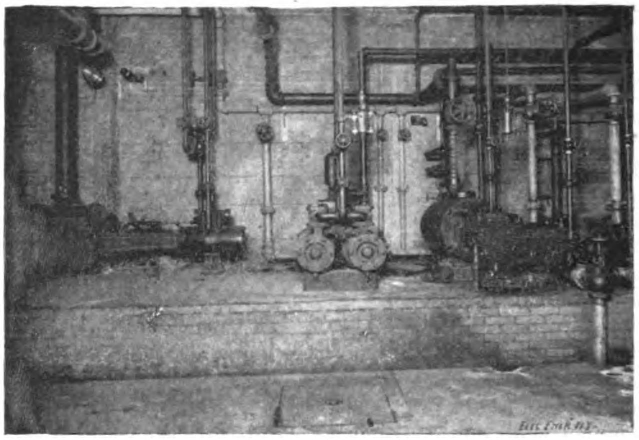


FIG. 34.—THE PUMP ROOM, POSTAL TELEGRAPH BUILDING.

XXII.—THE STAFF OF THE POSTAL TELEGRAPH-CABLE CO.

The following is a list of officers and employees in the Executive Offices of the Postal Co., in New York:

A. B. Chandler, President and General Manager; Wm. H. Baker, Vice-President; J. O. Stevens, Secretary; Chas. P. Bruch, Assistant Secretary; Edw. C. Platt, Treasurer; Theo. L. Cuyler, Jr., Assistant Treasurer; Edgar C. Bradley, Assistant General Manager; Geo. R. Williamson, Auditor; Isaac Smith, Superintendent of Tariffs; F. W. Jones, Electrician; M. M. Davis, Assistant Electrician; R. H. Robbins, Superintendent of Supplies; R. S. Guernsey, Attorney; J. H. Emerick, General Superintendent, Eastern Division; E. G. Cochrane, Superintendent 2d District, Eastern Division; G. H. Usher, Assistant Superintendent.

E. S. Butterfield, Cashier, New York; Wm. Horton Baker, Bookkeeper, New York office.

Executive Offices.—John Doran, in charge of claims; Albert E. Chandler and H. F. Hawkins, Stenographers; Joseph Manning and John Thornton, Clerks.

Auditor's Office.—Edward Alden, Bookkeeper and Chief Clerk; C. A. Rhodes, R. Vollbracht and Edw. G. Manning, Clerks.

Superintendent of Tariffs Office.—Chas. H. Seymour, Chief Clerk; Alvah P. Tobey, Thos. E. Hammond and F. H. Dennis, Jr., Clerks.

Electrician's Office.—S. F. Jones, Clerk.

Superintendent of Supplies Office.—W. D. Francis, Storekeeper; Geo. J. Everett, Shipping Clerk.

General Superintendent's Office.—T. J. Cusack, Chief Clerk; Roy Quick, Stenographer; Cornelius Cowley, Clerk.

Superintendent's Office.—Edward Reynolds, Chief Clerk; A. Kendrick, Stenographer.

Cashier's Office.—J. A. Manning, Cashier's Assistant;

E. S. Pigott, Chief Clerk; W. H. Hyde and A. H. Clarke, Clerks.

An interesting feature of the taking possession of the new executive quarters by the staff was the presentation by heads of various departments to Mr. Chandler, as a mark of their esteem, of a solid silver, richly chased and embossed, writing set for his desk.

The operating department, with much pride and pleasure, began occupancy of its new quarters on April 16, and, thanks to all the careful preliminary work lost no time in getting down to business, so that the only notice of the change to the outside world was a still further gain in the speed and efficiency upon which the Postal organization rests so properly its claim to public confidence and support. The completion of this admirable building and plant reflects great credit on the members of the Building Committee, and especially on Messrs. Baker and Platt, whose careful, constant and active attention to the details of every department greatly facilitated the work, and aided in securing the satisfactory results attained.

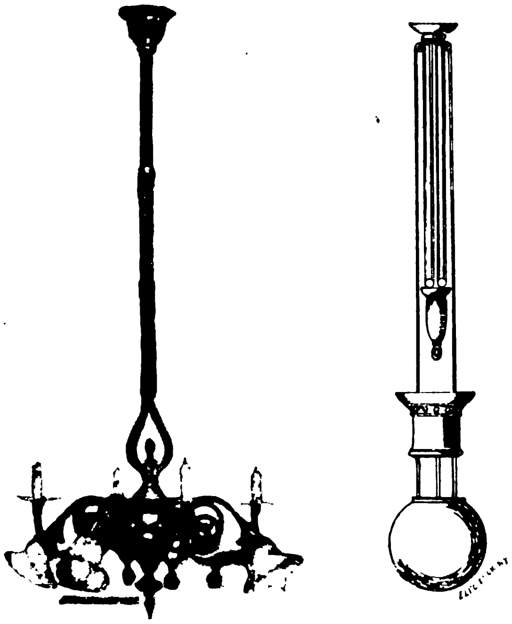


FIG. 85.—INCANDESCENT ELECTROLIER AND ARC LAMP.

XXIII.—A WORD ABOUT THE COMMERCIAL CABLE.

This article, long as it may have run, would not be complete without a brief reference to Mr. Mackay's submarine enterprise in the telegraphic field—the Commercial Cable Co. It is a happy and singular coincidence that last week, which saw the Postal and Commercial Companies, with Mr. Mackay, take possession of their sumptuous new executive headquarters saw also the dispatch of the "Faraday" from London, with about 500 miles of the first section of the Commercial Cable Co.'s new cable aboard. Her destination is Waterville, Ireland, from which point she will lay about 100 miles of shore end, proceeding next to Fox Bay, Canso, Nova Scotia, where she will lay and buoy 400 miles of shore end. She will then proceed to London, reload with cable, and lay the deep sea section in mid-Atlantic, finishing her work by about the beginning of July. The Commercial Co. will then have three first-class cables in operation. Mr. George G. Ward has courteously given us a few details about the new cable. Its conductor will be 500 pounds of pure copper per knot, with a dielectric of 320 pounds of gutta percha per knot, making the largest submarine core that has been laid anywhere up to the present time. The material employed in making the cable is 1,100,000 pounds of copper, 800,000 pounds of gutta percha; 9,500,000 pounds of steel wire; 1,300,000 pounds of jute yarn, and 1,800,000 pounds of compound; all of which any plain, ordinary citizen can avail himself of any hour of the day or night, with all the company's terminal facilities, for the absurdly small sum of 25 cents per word. Such figures give an idea of the enormous investment needed in an ocean cable, and the modest tariff asked nowadays for the support of the service. The length of the new cable is 2,200 nautical miles, and the guaranteed speed is 33⅓ per cent. greater than that of the existing Commercial cables, fast as those are. Every inch of the core has been tested with 5,000 volts alternating current. A large portion of the copper for the core was furnished by the Roeblings, and is eight-tenths of one per cent. above the guaranteed high purity of 98 per cent. The cable has been manufactured by Siemens Bros. & Co., Ltd., of London, of which Mr. Alexander Siemens, who visited this country last year, is the managing director; and the Commercial Co.'s representative during manufacture and laying is Mr. John Gott, who has talked cable in his sleep since 1865, and who knows pretty well every nook and dingle at the bottom of the Atlantic.

The Commercial Cable Co., alert, progressive and admirably directed, will now own nearly 10,000 miles of the latest and best submarine cable, in three cables, and their loops, and is doing such good work in the introduction of automatic working and the Cuttriss improvements, as well as in other ways, that to record its brilliant success is a pleasure to everyone interested in the welfare of the great submarine cable art and industry.

THE WARREN ALTERNATE CURRENT ENGINE-DYNAMO.

A familiarity with the past evolution of machines for the conversion of mechanical into electrical energy is scarcely necessary for an appreciation of the advantage possessed by a combination of prime mover and electric generator in one and the same machine. While considerable development in this direction has recently been going on among manufacturers of electrical apparatus, the improvement has been practically confined to machines of the direct current type. With one notable exception, little has been done, in the United States at least, in the line of combination engines and alternators of large output. The Warren "engine-dynamo," illustrated in the accompanying engravings, is the outcome of several years of careful study on the subject and practical experience in the electrical field, by Messrs. C. C. and H. B. Warren, of the Warren Electric Company, Chicago.

By those familiar with the more recent forms of alternators, the dynamo will at once be recognized as belonging to the "inductor" type, the fly-wheel of the engine constituting the only moving part of the generator proper. The engine wheel is, in fact, in this case, the essential feature of the electric generator, and being an integral part thereof, performs a double service, both its inertia (or momentum) and its magnetic properties being utilized. In the past a serious defect of slow speed engines, when applied to electric service, has been apparent from fluctuations in the engine speed during a single revolution, and was due to a lack of sufficient metal in the fly wheel. Progressive engine builders are now correcting this defect, by very largely increasing the weight of the fly wheels furnished with their engines; hence the increased weight in the "engine-dynamo" is claimed to be in the direct line of progress, instead of being an objection, as might appear at first thought.

The engraving, Fig. 1, shows a 200 k. w. (4000 light) direct connected alternator and tandem-compound engine. Fig. 2 shows a section of the fly-wheel, F, which also serves as field magnet core for the dynamo. For this purpose it is provided with a number of polar projections P on its rim, the projections being cast integral with the wheel; the latter being either cast in two, four or more segments, or all in one. The number of polar projections depends of course on the speed of the engine and the desired frequency of alternations. In the machine illustrated the speed is 134 r. p. m., the number of poles 112 (56 on each side) giving a frequency of 127 per second. These polar projections are provided with laminations L in their presentation faces, to prevent heating from eddy currents. These laminations are either mechanically attached or cast in position.

The illustration also shows the field magnet coil, with the supporting case into which it is wound. The field coil proper, W is wound on an insulated flooring of fibre I, while K represents an angle iron frame to which the fibre flooring is riveted. This frame is formed of iron rolled to shape, and to a proper curvature. It is made in several sections, fitted in the shop, but knocked down for shipment. The magnet winding is put on after the wheel is in position and the case set up around it. The operation is easily performed by clamping the case to the wheel and slowly turning the two, this being one of the duties of the erecting engineer, who is provided with proper instructions regarding the number of turns, size of wire, etc. The field magnet coil and case do not, of course, revolve in the completed machine, but are supported and maintained stationary. It will be noticed that this field coil does not entirely fill the case radially but allows the frame to form a considerable flange. The object of this flange is to provide a support for the armature coils, C, or more properly speaking, armature cases, G, to which in turn is secured a supporting ring.

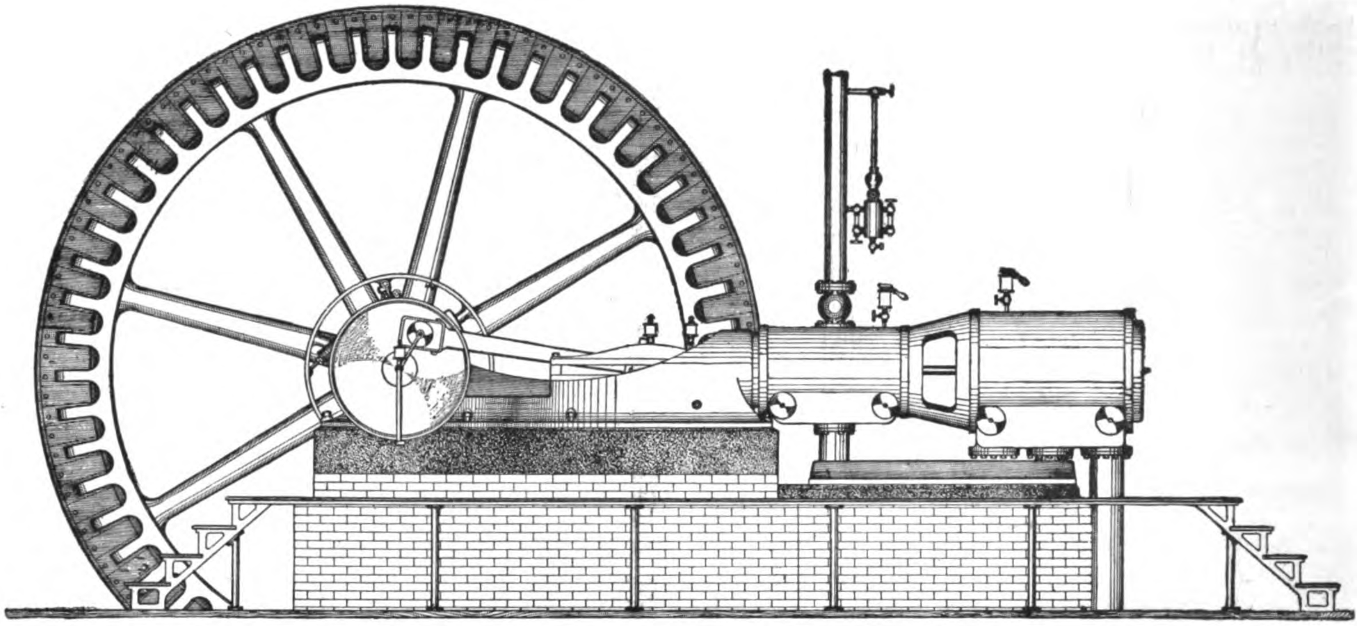


FIG. 1.—THE WARREN ALTERNATE CURRENT ENGINE-DYNAMO.

There are 112 armature bars, the number corresponding with the number of pole pieces. These armatures are built up of punched laminations of No. 28 or 30 sheet iron. The laminations are clamped together by means of three insulated bolts, the two end bolts being longer than the middle one, for the purpose of securing the armatures to the supporting ring, as clearly shown in Fig. 3.

The armature coils are rectangular in shape, wound on a suitable form, insulated, taped and completely embedded in protecting cases, G, G. These cases, the designers say, can be made of wood, fibre, porcelain, glass, slate or any material which can be easily formed or moulded, and possesses high insulating qualities. The coil cases are attached to the supporting ring by means of screws. The back surface of the coil case is recessed to within ¼ inch of the face, this recess being of such shape, and so located that the case caps over the end of the armatures bar. It will be readily seen that the arrangement of the coil cases, between the outer and inner supporting rings, continued entirely around the circle, and on both sides of the machine, provides a seat or double stirrup for the field magnet coil and case, and at the same time locks the armature coils in position. Any individual coil case, however, can be easily removed by taking out the one screw, which fastens the case to the stationary supporting ring.

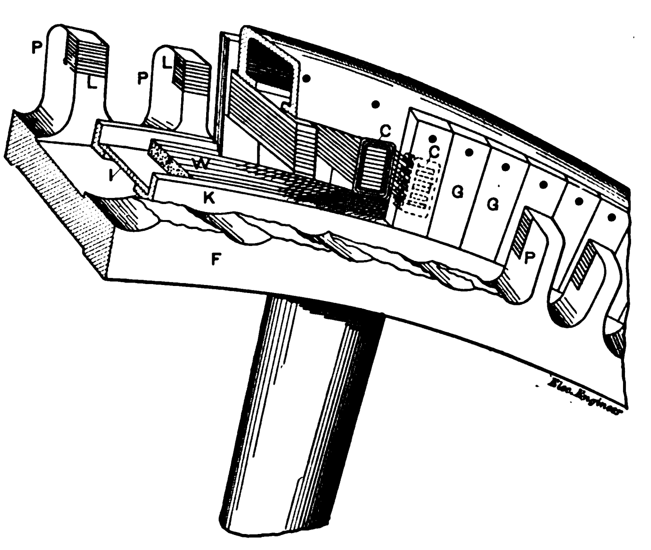


FIG. 2.—MAGNETS AND ARMATURE OF WARREN ENGINE-DYNAMO.

From the above description of the various details of the machine, the reader has no doubt by this time gathered that it consists simply of a multipolar field having a single exciting coil, all the polar projections on one side being of the same polarity. The magnetic circuit from one pole to the oppoite one is closed by stationary armature bars on the ends of which are mounted the armature coils. It follows that the arrangement of the armature coil connections is susceptible of a great many variations, making it possible to readily adapt the machine to high or low voltage, so that the circuits may be divided to suit existing requirements.

Following are the principal data for a 200 k. w. machine: Speed, 134 r. p. m.; power required, 275 h. p.; current, 182; E. M. F., 1,100 volts; frequency, 125; diameter of wheel over all, 17 feet, 4 inches; diameter of wheel at face, 15 feet; width of wheel over all, 30 inches; thickness of rim, 4¼ inches; diameter of shaft, 12 inches; radial length of pole-pieces, 14¼ inches; section of pole-pieces, 3 inches by 7 inches; number of pole-pieces, 112; total moving weight exclusive of shaft, 36,360 pounds; peripheral speed of rim, 6,312 feet per minute; centrifugal strain on rim, 21 pounds per square inch; centrifugal strain on spokes, 4,024 pounds per square inch; weight of field magnet and case, 4,275 pounds; weight of armature bars, 7,460 pounds; weight of armature coils and cases, 1,440 pounds; weight of supporting rings and lugs, 3,500 pounds; weight of copper wire in field and armature, 4,833 pounds; total weight of machine, 53,035 pounds.

GENERAL ELECTRIC AFFAIRS.

The annual meeting of the General Electric company was held at its offices in Schenectady on April 10. Proxies on a very large block of stock were voted by Oliver Ames, 2d, of Boston and the old board of trustees of last year was reëlected. The date of the stockholders' annual election was changed from the second Tuesday in April to the second Tuesday in May. The fiscal year ends December 31. The number of directors was changed from eleven to thirteen. No election of officers took place. From conversation with some of the directors it was inferred that they would be the same as last year, and that the election would take place in New York. It is understood that the officers are to give their early attention to a reorganization in order to reduce the capital stock to the value indicated by the loss of over $12,000,000 last year, as shown by the balance sheet lately made public.

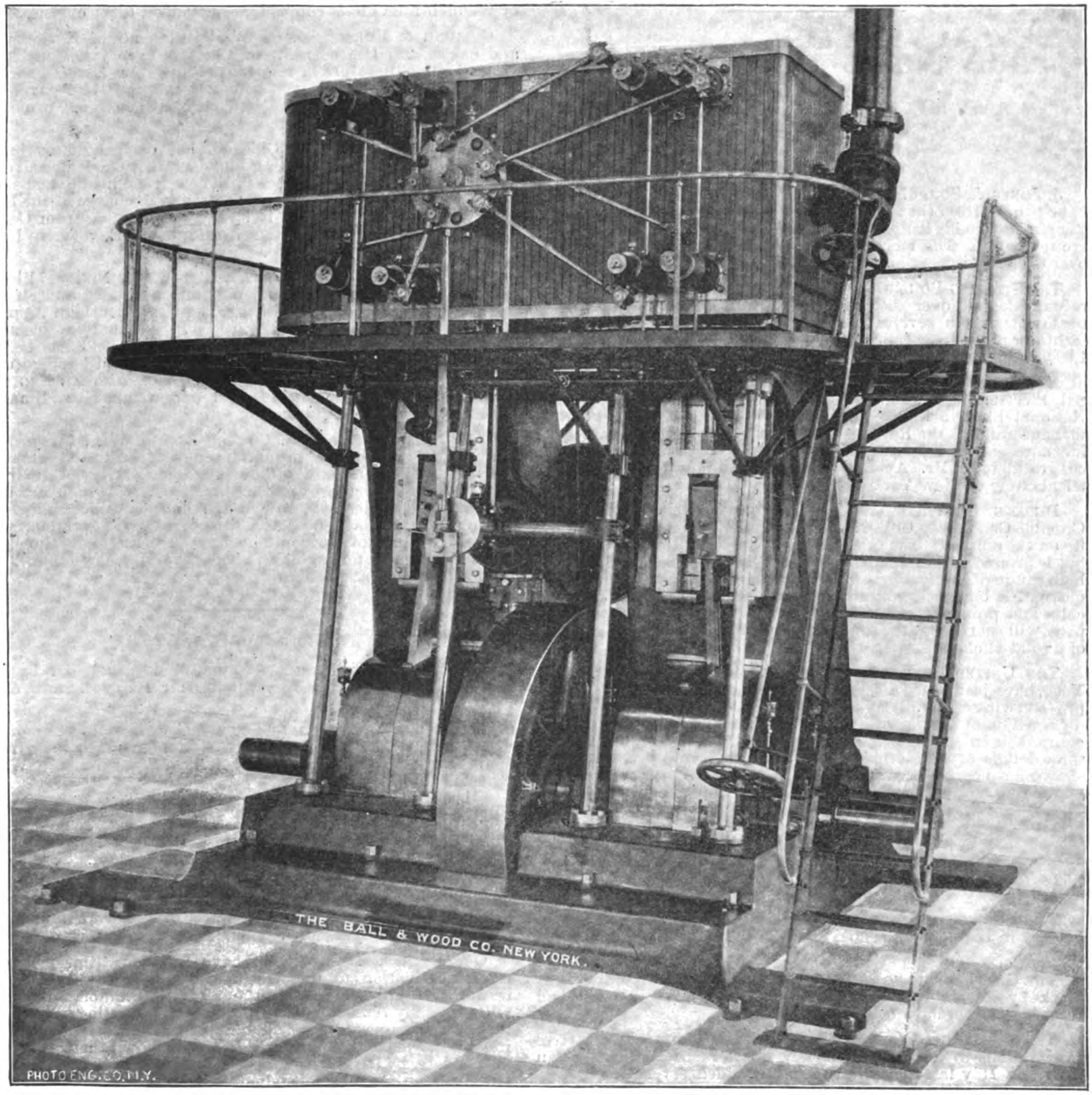
NEW YORK-WASHINGTON ELEVATED ELECTRIC RAILWAY.

A bill has been introduced in the House of Representatives at Washington by Mr. Catchings of Mississippi, contemplating the building of an elevated electric railway from this city to Washington. The capital is placed at $15,000,000.

THE NEW BALL & WOOD VERTICAL COMPOUND ENGINE.

The Ball & Wood Company, of 15 Cortlandt street, this city, have just completed at their Elizabeth works a new type of vertical compound engine which is believed to embody a number of original and valuable features. At the invitation of the company a number of prominent engineers were present at the private "trial trip" of this engine on March 31, and it is with pleasure that we now give a detailed and illustrated description, the data for which was unavailable at that time.

The engine, a front view of which appears here, is of 600 h. p., non-condensing. The cylinders are 19 and 31 inches in diameter with a 24 inch stroke, and the engine runs at 150 revolutions a minute with 125 pounds initial pressure. The best steam distribution is obtained, it is thought, with some form or modification of the Corliss wrist plate motion and valves, and the smallest possible clearance is obtained by placing these valves in the cylinder heads. This arrangement, then, has been adopted in the engine under consideration.



New Ball & Wood 600 h. p. Vertical Compound Engine.

The Corliss releasing gear practically limits the rotative speed to about 100 revolutions per minute, or less, but in this engine the automatic cut-off is obtained by independently operated cut-off valves placed inside the steam valves, and actuated by a specially designed governor. This arrangement places no restriction on rotative speed, which is decided by other considerations, and the aim has been to find a medium unobjectionable to the slow speed advocates.

The governing mechanism of the engine is of special interest to the student of valve gears. Beginning with a well-known form of shaft governor, the principles of which have attracted the attention and admiration of the ablest engineers of the day, the superb regulation thus obtained is made effective by transmitting the necessary motion to the cut-off valves through a special wrist plate device, in which a compound motion is obtained, and the cut-off valves at all points of cut-off operate relatively to the main valves just as though the latter were standing still, thus preventing wire-drawing of steam at any point of cut-off.

The location of the valves in the cylinder head, giving as it does the shortest possible ports, admits of their being of ample capacity without an appreciable increase of clearance.

The peculiar motion of the cut-off valve utilizes these wide ports to the fullest possible extent, and the cut-off motion at every point from zero to three-quarter stroke is a rapid one, in fact as rapid as is obtained from the releasing gear, because of the higher rotative speed of the engine.

Another feature of great importance in this gear, particularly with compound engines, or where moments of excessive overload occur, is its ability to cut off at three-quarter stroke, while the Corliss gear is limited to about half-stroke.

While this engine is eminently suited to any service requiring stationary engines of the highest efficiency, it has special features of adaptability to the work of driving dynamos built upon the engine shaft and free from any encumbrance. The one described, the first of its type, is intended for this service in the station of the Chicago Edison Company.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW YORK NOTES.

J. Jones & Son, 67 Cortlandt street, notify the trade that they have bought from the receiver the stock of Alexander, Barney & Chapin, now in his hands at the above address, to which point they are removing. The stock was bought for cash and is valued at over $10,000.

The Stirling Boiler Co. have just issued a very meaty list of recent sales all over the country, aggregating several thousand horse power. In several instances the orders are the seventh, eighth or ninth from the same concerns. Topping the list is one of 1,500 h. p. from the McCahan Sugar Refining Co., of Philadelphia.

Mr. James I. Ayer, E. E., formerly manager of the Municipal Electric Light Co., of St. Louis, and ex-president of the National Electric Light Association, has accepted the general managership of the Royal Arc Electric Co., owning the Howard incandescent arc light patents and system. Both parties are to be congratulated. Mr. Ayer will be a welcome addition to the electrical circle of New York city.

Dixon's Graphite Cycle Lubricant.—The Joseph Dixon Crucible Co., Jersey City, N. J., are putting a Cycle Chain Graphite on the market. The graphite is not only of the choicest stock, but is ground to an impalpable powder, and then reground with a high grade of lubricating oil. This material, when applied to the chain of a bicycle, penetrates the bearings and thoroughly lubricates and protects them from wear and rust. The Dixon Company will shortly put the same material on the market in the form of a solid stick.

The United Columbian Electric Co., 280 Broadway, New York, have just issued a very neat pamphlet in regard to their improved twin series railway motor, well illustrated, and devoted to a discussion of the reasons why street railway companies should equip their cars with twin series motors. This is accompanied by some details of a test made on the Union Railway, New York, showing a notable economy for the twin motor over other forms and makes, and figuring out a saving of $250 per car per annum. There is also a neat testimonial from the Suburban Rapid Transit Street Railway Co., of Pittsburgh.

WESTERN NOTES.

The Sunbeam Lamp Mfg. Co., of Chicago, are permanently located in the new Chicago Title & Trust Bldg., 100 Washington St.

The Graff Telephone Co., Chicago, was incorporated last week by Ed. D. Hoy, Calvin W. Ream, Wm. R. Tucker and others. The capital stock is $1,000,000.

The Wallace Electric Co., Chicago, are making active preparations to move to their new quarters in the Manhattan Bldg., on May 1st. They have recently added several new specialties to their line of goods.

Milwaukee, Wis.—The Wisconsin Telephone Co. is in trouble with its patrons over an order limiting subscribers to 1,000 calls a year and charging 2 cts. for every call in excess of that number. It is alleged that a large number will abandon the use of 'phones if the company enforces the order.

Mr. Chas. Blizard, general sales agent of the Electric Storage Battery Co., who came to Chicago some time ago to introduce the chloride accumulator, has returned to Philadelphia, after a very successful trip, leaving the business in Chicago in the hands of Messrs. Pierce & Richardson, No. 527 Manhattan Bldg.

George Cutter, of Chicago, has issued a catalogue of the china specialties of Pass & Seymour, for whom he is the western agent. It is well illustrated and indicates that these well known and valuable articles are to be as popular in the vicinity of Chicago as they have become here.

Mr. Geo. E. Fisher, Gen'l. M'gr. of the Commercial Electric Engineering Co., Detroit, Mich., was in Chicago last week. This company are agents for Michigan, Ohio and Indiana, for the Standard Electric Co., and although established but a short time, have already closed several important lighting contracts.

The Pumpelly-Sorley Storage Battery Co., Chicago, have just closed a contract for furnishing a complete battery plant for the Kent apartment building, cor. 43d and Calumet Ave., Chicago. This is to supplement the regular lighting plant consisting of Waddell-Entz direct coupled generators on Ideal engines.

Cushing & Morse, general Western agents of Kerite wires and cables, 225 Dearborn street, Chicago, have just issued some very effective literature in request to those time honored specialties. They also circulate neat little "sticking plaster" envelopes, for the benefit of their friends who may have cuts and bruises to be taped.

Mr. Geo. L. Thayer, Chicago, has opened offices in the Monadnock Bldg., as consulting and constructing electrical engineer. Mr. Thayer's experience in the electrical field extends over a number of years; beginning as electrician in charge of the lighting plants of the C. & N. W. Ry. After graduating from Cornell he entered the employ of the Westinghouse Co., where he remained until a short time ago.

Mr. W. M. Lenhart, late Gen'l. M'gr. of the National Electric Manufacturing Co., Eau Claire, Wis., has associated himself with the Standard Electric Co., Chicago, as Gen'l Southern Agent at Atlanta, Ga. Mr. Lenhart's experience in matters electrical covers so long a period, and his success in the field has been so uniform as to make the introduction of "Standard" apparatus in the South an easy matter for him. **The Electrical Engineer** wishes him the best of success and congratulates the Standard Co. on securing his services.

The Racine Boat Mfg. Co., of Racine, Wis., forward us a copy of their very handsome and interesting illustrated catalogue. It gives an excellent idea of the range and variety of their product, as well as of the excellence of the craft, which are in all sizes and include canoes, row boats, hunting boats, sail yachts, steam yachts, gas launches, etc. The company is now undertaking the manufacture of electric launches. The catalogue shows also the Racine automatic engine and boiler, a well-known make, and the Racine porcupine boiler.

PHILADELPHIA NOTES.

The Technic Electrical Works, of Philadelphia, has just completed a large order for switches for Harry S. Smith & Co., Ltd.

The Breese & Mansfield Co., the electric railway engineers, of 1120 Betz Building, Philadelphia, announce to their friends and the public that they have taken the agency for the Walker dynamos and motors.

Harry S. Smith & Co., Ltd., who represent the Interior Telephone Co. in Philadelphia, report several sales. Among recent installations are the following: Drexel Institute, Strawbridge & Clothier, Sharpless Bros. and the Friends' Asylum.

Mr. W. W. Harrison, of the Franklin Sugar Refining Co. is about to install an elaborate steam and electric plant for his residence at Glenside, Pa. The contract for this work will include engines, boilers, dynamos, piping and storage batteries.

Queen & Co., Philadelphia, have for some time past given especial attention to the design of apparatus for the electrical testing of cables. Visitors to the World's Columbian Exposition will especially remember their portable cable testing set exhibited there, on account of its very great compactness. That their work in this line is being appreciated has been shown them very agreeably of late, by large orders for this kind of apparatus; the Electric Traction Co. of Philadelphia having recently purchased one, and the Philadelphia Traction Co. two, extensive sets for measurement on electric cables.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVII. APRIL 25, 1894. No. 312.

SMALL ARCS OR LARGE INCANDESCENTS?

BY

Albert Scheible

THE discussion which has recently been started on the opening for small arc lamps leads us to speculate on the apparent limitations of these as they decrease in candle power and the probable line of demarcation between them and the large incandescents. Indeed it seems to me that we are viewing but one phase of the question when we consider the small arcs alone, as many of the arguments advanced in their favor hold equally well for incandescent lamps of higher candle power than the ordinary. The shortcoming need not lie entirely in the old size of arc lamps, but may be in the whole series of electric lighting units, which shows an immense gap between the high candle arcs and the small incandescents.

The older workers who were familiar with the cry of a dozen years ago—"the subdivision of the electric light"—will remember how decided a want was met by the incandescent lamp, and how this immediately commanded the attention of electrical workers, it being even thought by some that the arc lamp was doomed altogether. And we who have watched other pendulum-like tendencies in electrical developments can see how the concentrated energy of a host of exploiters was easily turned from the large arc lamp to the far smaller incandescent, though the former has still held its own until both have come down to us side by side in their more perfected forms. Of course there have been several sizes of incandescents, more particularly the ten, sixteen, thirty-two and some of fifty candles; and there have been arc lamps of 1,200, 1,500 and 2,000 c. p.; but, after all, these represent but two series of sizes near the extremes of the scale, while there really is a demand for all the intervening sizes as well.

So we are at last confronted with the fact that the needs of electric lighting call for a graded series of units, ranging all the way from ten to two thousand candle power, there being at present a decided gap between the fifty and the thousand. That the small arcs will do much towards filling a part of this gap (perhaps all that lies above three or four hundred c. p.) seems evident from the more recent developments. But I think we must look to the incandescent lamp in its larger sizes for the rest. Of course the lower efficiency of the latter as compared with the arc lamp counts against it, but the efforts now being made by various investigators promise some practical results in raising this efficiency. The prolonged litigation over the vacuum lamps has driven many lamp makers to experiments along new lines and some of their work may do much towards helping the large incandescents. What is more, the competition on the small sizes has narrowed the manufacturer's profit so much that he is on the lookout for other styles that leave him a better margin, and the few firms who are in position to supply lamps of several hundred candle power are already reaping some of the harvest. Happily, less is at present expected of these large incandescents as regards life for a certain efficiency, since they fill a line in which the consumers have not yet been spoilt. And even if the expectation of some of the experimenters—the production of a three hundred hour, one watt per candle lamp—is only partly realized, there still seems to be a good opening for incandescents in sizes up to three and perhaps four hundred candle power.

In this connection it is interesting to note the comments of the Edison lamp expert, Mr. J. W. Howell, on Prof. Anthony's recent paper. When Mr. Howell remarks that the 16 and not the 32 c. p. lamp represents the best lamp making of to-day, can we not infer that there is still room for considerable development of the 50, 100 and 200 c. p. lamps? Mr. Howell's comments, and indeed the whole discussion of Prof. Anthony's paper, tends to show that further perfection of the incandescent lamps may soon be expected, and I for one believe that the high candle power lamps will get some of that attention which they have long been needing. Just where the line will be drawn between them and the small arcs remains to be seen, as the developments in methods of distribution by either direct or alternating currents lend themselves equally readily to both forms. Probably it will depend partly on the result of the work already mentioned, which involves the making of the filaments as well as the nature and density of the surrounding atmosphere. At any rate, we may expect to see the incandescent lamp entitled to a good share of the medium candle-power lighting which is now being exploited, so that we should not lose sight of it amid the stir over that timely newcomer, the small arc.

ENERGY, CURRENT AND CANDLE POWER OF ARC LAMPS.

BY

Frank B. Widmayer

TABLE I. given below shows the current required for arc lamps of the various systems of arc lighting with constant current, which, I think, will be found quite useful in an electrical repair shop, where lamps are sent in to be repaired and then readjusted. The table gives the normal current of the various systems and the so-called (trade) candle power of the same.

TABLE I.—CURRENTS IN AMPERES.

System.	800 c. p.	1000	1200	1600	2000	3000	4000
Ball	4.		6.&6.4	8.	10.	15.	
Edison (Sperry)			6.4		10.		
Easton			6.	8.	10.		
Brush			6 4		9.6	15.	20.
Thomson-Houston		5.	6.8		10.	15.	
Western Electric					9.6		
Clark					9.8		
Schuyler					9.5		
U. S. Old Western Electric } Low Tension					18.		
Excelsior					10.		
New Wood or Ft. Wayne	4.2		6.8		9.5		

TABLE II.—CANDLE POWER.

So-Called Candle Power.	Watts Per Lamp.
2000	450 to 500
1600	384 to 416
1200	278 to 310
800	200 to 226

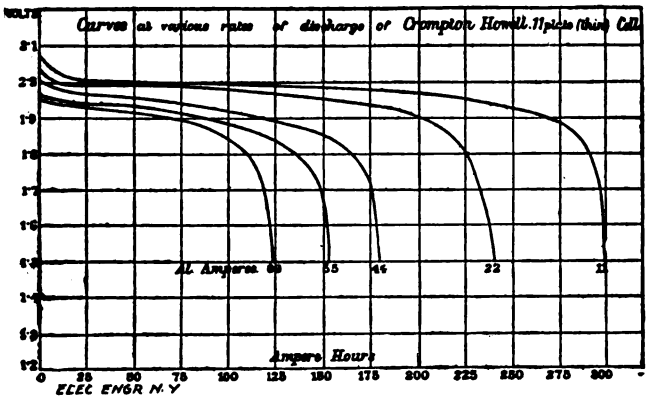
Table II. shows the number of watts consumed by lamps of various systems and their relation to the so-called candle power; these results were obtained from a number of readings and the averages are given in the tables.

STORAGE BATTERY TESTING.

BY

Robert McA. Lloyd

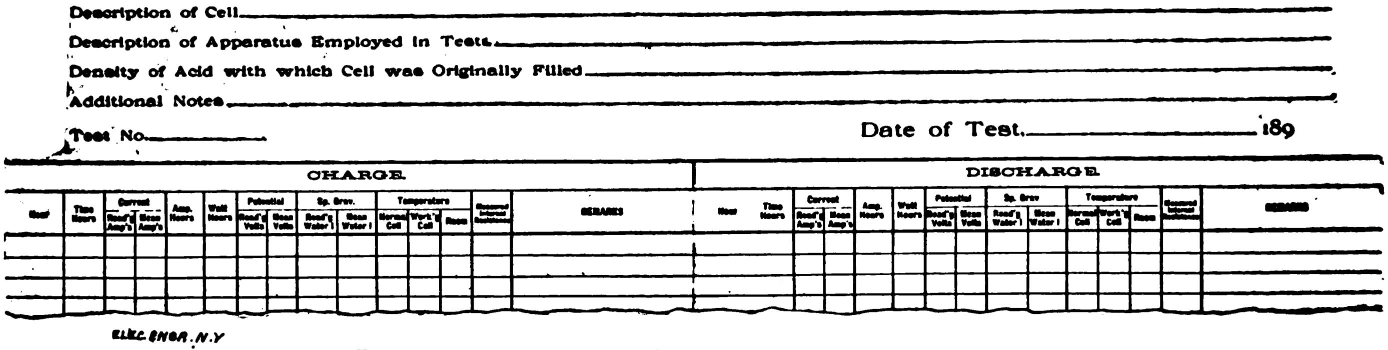
In view of the increasing interest in storage batteries, this seems to be a good time to make some suggestions in regard to testing them, partly because many cases will arise where the purchaser of a large installation will require an expert report upon samples furnished, and also because there are always a number of inventors going about trying to interest capital in new batteries, and engineers must be consulted in regard to their merits.



Curves Showing Capacity at Various Rates of Discharge.

The following list of headings form a basis, imperfect perhaps, upon which a report may be drawn :—

1. Investment per watt-hour capacity.
2. Annual cost " "
3. Watt-efficiency at normal rates.
4. Internal resistance, accurately determined.
5. Weight of cell, itemized.
6. Watt-hour capacity per unit weight of elements.
7. Discharge rate per unit weight (for motive purposes).
8. Curves showing potential difference at terminals through period of charging with constant current at different rates for each curve.



Description of Cell__________

Description of Apparatus Employed in Tests__________

Density of Acid with which Cell was Originally Filled__________

Additional Notes__________

Test No._____ Date of Test__________189

CHARGE															DISCHARGE														
Hour	Time Hours	Current		Amp. Hours	Watt Hours	Potential		Sp. Grav.		Temperature			Measured Internal Resistance	Remarks	Hour	Time Hours	Current		Amp. Hours	Watt Hours	Potential		Sp. Grav.		Temperature			Measured Internal Resistance	Remarks
		Read'g Amp's	Mean Amp's			Read'g Volts	Mean Volts	Read'g Water 1	Mean Water 1	Normal Cell	Work'g Cell	Room					Read'g Amp's	Mean Amp's			Read'g Volts	Mean Volts	Read'g Water 1	Mean Water 1	Normal Cell	Work'g Cell	Room		

ELEC. ENGR. N.Y

Form for Tabulating the Rates of Charge and Discharge.

9. Same for discharging.
10. Normal and maximum charging rate } deduced
11. " " " discharging rate } from
12. Working limits of potential on charging } curves
13. " " " discharging } 8 and 9
14. Apparent or observed liability to breakdowns and stoppages.
15. Whether there are objectionable odors or fumes.
16. Character of electrolyte; working limits of its specific gravity; and how kept in circulation.
17. Accurate description of complete cell including character or materials, methods of manufacture, and drawings.
18. Rated capacity.
19. Mean capacity.
20. Mean available capacity.

Accompanying this is a form in which the readings of charges and discharges may be tabulated and a set of curves, given by Crompton in the *Journal* of the London Institution of Electrical Engineers, page 691, Vol. XIX, illustrating the subject of the above 9th division.

The first tests to be made are with a view to laying out such a set of curves. One cell should be used for each test; that is, one charge and discharge, and a curve plotted from it. Each test should be repeated with another cell. Cells for these tests should be new, and in the best possible condition.

Out of a series of discharges from five or six similar cells, at as many different rates the proper rate can be selected, and the minimum potential determined. These curves are to the storage battery expert what indicator diagrams are to the steam engineer. They show at what rate and to what potential the discharge may be made. I should say that the best rate for this cell was 22 amperes, and that the minimum limit of potential with this current flowing should be 1.9 volts. By letting it fall to 1.8 volts, an additional 25 ampere hours or 12 per cent. would be gained, but at a lower efficiency, with increased difficulty of regulation, and with detriment to the plates, both positive and negative. The best normal discharging rate may usually be adopted for the charging rate.

All the divisions of the accompanying report except the second may now be filled in without further tests. It is customary to rate the capacity at the greatest number of ampere-hours obtained by discharging at the normal rate to 1.8 volts, and this rule should be followed in the report. The mean capacity is approximately midway between the rated capacity, and the capacity of the cell at its worst. For example, a 1,000 ampere-hour cell may be used until its capacity falls to 700, and the mean capacity will therefore be 850. The mean available capacity is the mean capacity in a service where the cell is never used below 1.9 volts which would be perhaps 25 per cent. less, or 612 ampere-hours. Any other figure may be substituted for 1.9 if found to be the lowest potential at which the cell can be profitably worked. It will be understood, however, that I am here treating particularly of lead cells.

The most difficult point is division 2. It is impossible to determine from one kind of service what a battery will do in some other kind. A laboratory test of durability is interesting and may tell something of a battery, but it may also be misleading, and I would rarely recommend the consulting engineer to undertake it. For a good battery, two years at least will be required, a laboratory in which there is nothing else going on, and day and night assistants with no other duties to confuse them. It would be desirable to reproduce in the laboratory, as far as possible, the commercial conditions under which the battery is intended to be used; the charging and discharging rates, the working potentials, the specific gravity, temperatures and circulation of electrolyte. But in the laboratory there must be regularity and this regularity shortens the life of one cell, while it lengthens the life of another. Furthermore, it signifies nothing that one battery can stand what is called a breakdown test better than another. They are not like steam boilers. To discharge two batteries a hundred times or more at ten times their respective normal rates, provides no data upon which to calculate or compare their durabilities in commercial service.

In making a durability test I charge at the normal rate to 2.3 volts and discharge to 1.9 at the same rate, beginning the charge and discharge each day at the same respective hours. When the capacity of the cell has fallen to 70 per cent. of the maximum, the positive and negative elements are separated and reassembled each with a new element, and the test continued with whichever one has a capacity over 70 per cent. of the original maximum. In this way the length of life between maximum capacity and 70 per cent. of it, in terms of discharges, is determined for both positives and negatives, and a man who had previously combined some commercial with his laboratory experience, might be able from such data to make an approximate estimate of the cost of maintenance.

Such a test should be conducted with at least two cells simultaneously; but under no circumstances should they be charged or discharged in series. I need hardly say that great care should be exercised in getting accurate measurements. Separate sets of instruments should be used for each cell. Lord Kelvin's quadrant electrometers will be found preferable for measuring the potentials. The measurements for internal resistance require such delicacy as to demand special treatment; but I may say that little dependence can be placed upon the figures usually given for this quantity.

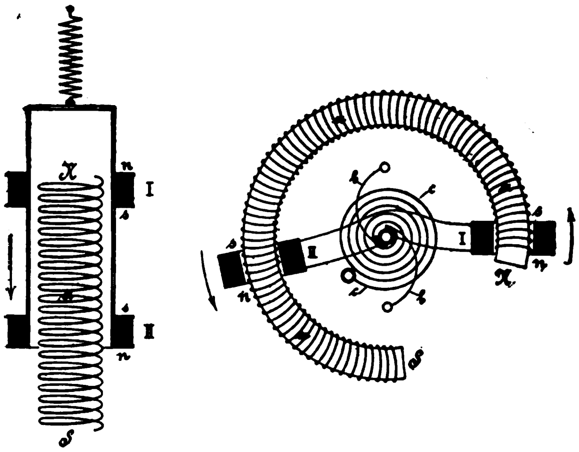
In regard to the limits of working potential here suggested, I should add that it is customary to charge up to 2.4 and discharge to 1.85. The circulars and printed instructions of the principal manufacturers give these figures, but the tendency of the best modern practise is toward narrower limits. (See *Journal* of London Institution of Electrical Engineers Vol. XIX., page 561.) It must not be supposed that the above described durability test is particularly light service for any battery. Some batteries can withstand very rough and irregular commercial use better than they can a great number of successive charges and discharges of similar quantity and character. It is possible to make a fine cell for this work that would not possess the greatest merit as a commercial investment, and it would be equally possible to construct one that would make a good record in commercial work, and yet would be a poor competitor for honors in the above test.

THE BRUGER SOLENOID MEASURING INSTRUMENT.

The inaccuracy in the readings of electrical measuring instruments due to the inconstancy of the magnets employed has been an annoying source of trouble in many forms of apparatus. To avoid this difficulty Mr. Theodor Bruger, of Bockenheim, Germany has recently produced a device the construction of which is based on the mutual action of two co-axial solenoids, one of which is stationary and the other movable relatively to the stationary one, in such a manner that a considerable sensitiveness and an accurate scale are obtained.

In Fig. 1 of the accompanying illustrations *a* represents a stationary polarized solenoid which acts simultaneously on two co-axial short solenoids I and II, rigidly connected with each other but having a common movement and joined in series or parallel in such a manner that the succession of their poles is positive-negative and negative-positive.

If one of these movable solenoids be moved slightly toward the stationary solenoid in the direction of the arrow, the strength of the current being constant, the motive power which is exerted on the solenoid I, decreases rapidly during the movement from the positive end N of the solenoid *a* to its centre. If therefore, the solenoid I is under the influence of a variable current and the opposite solenoid II under the influence of a spring or of gravity, a scale is obtained with sub-divisions which decrease in size. If on the contrary the solenoid II alone is moved on the solenoid *a* from the centre of the latter toward the negative end s and is subjected to the same influences as the solenoid I, a scale is obtained the divisions of which are very small at the beginning of the movement and increase rapidly when the solenoid II approaches the negative pole s. Hence it follows, that by the simultaneous use of the two solenoids I and II an equalized movement is obtained which produces a nearly uniform scale.



Figs. 1 and 2.—The Bruger Solenoid Measuring Instrument.

In alternating currents also the mutual induction which would occur between a fixed coil and a movable solenoid is avoided in consequence of the opposed polarity of the two movable solenoids.

Fig. 2 shows the arrangement and connections. The stationary straight solenoid *a* of Fig. 1 is here replaced by a circular solenoid, and the two movable solenoids I and II are mounted on an axle. The current is admitted through narrow silver bands *b*, while the torsion spring *c* acts against the turning action of the current.

This instrument can, according to its winding, be used for various purposes. If designed for watt-meters the stationary solenoid is provided with a thick wire for the main current and the movable coils are placed in shunt, while the stationary solenoid is tapered toward the ends so as to obtain a uniform scale. If the instrument is to be constructed as an electro dynamometer, the movable solenoids are connected with the stationary solenoid either in parallel or in series, as the case demands.

THE CONNECTICUT STREET RAILWAY ASSOCIATION.

Representatives of the various street railway companies of Connecticut, have formed the Connecticut Street Railway Association. Roads are represented in Derby, New Haven, Waterbury, Stamford, Hartford, Fair Haven, Westville and Norwalk. The following officers have been elected: President, H. Holton Wood, Derby; vice-president, Henry S. Parmelee, New Haven; treasurer, E. L. Goodrich, Hartford; secretary, R. A. Fosdick, Stamford; executive committee, A. M. Young, Waterbury; G. A. W. Dodge, New Haven; Israel Kelsey, New Haven. Monthly meetings will be held, with the annual meeting the third Wednesday of November.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—X.

BY

Mary A. Henry

There were two practical applications of his electromagnets that Henry had in mind; one the telegraph, the other the machine described in *Silliman's Journal*, Vol. XX., 1831. This should be of interest to the reader since it is the first *electro-motor*. This crude instrument, made by Henry's own hands, has been preserved by Princeton College as an historical relic.[1] Let us read Henry's description of it in *Silliman's Journal* (Vol. XX., pp. 340–348).

"To the Editor:

Sir:—I have lately succeeded in producing motion in a little machine by a power, which, I believe, has never before been apapplied in mechanics—by magnetic attraction and repulsion. It is well known that an attractive or repulsive force is exerted between two magnets, according as poles of different names, or poles of the same name, are presented to each other. In order to understand how this principle can be applied to produce a reciprocating motion, let us suppose a bar magnet to be supported horizontally on an axis passing through the centre of gravity, in precisely the same manner as a dipping needle is poised; and suppose two other magnets to be placed perpendicularly, one under each pole of the horizontal magnet, and a little below it with their north poles uppermost; then it is evident that, the south pole of the horizontal magnet will be attracted by the north pole of one of the perpendicular magnets, and its north pole repelled by the north pole of the other; in this state it will remain at rest, but if, by any means, we reverse the polarity of the horizontal magnet, its position will be changed and the extremity which was before attracted will now be repelled; if the polarity be again reversed, the position will again be changed, and so on indefinitely. To produce therefore, a continued vibration, it is only necessary to introduce into this arrangement some means by which the polarity of the horizontal magnet can be instantaneously changed, and that too by a cause which shall be put in operation by the motion of the magnet itself. How this can be effected will not be difficult to conceive when I mention that instead of a permanent steel magnet in the movable part of the apparatus a soft iron galvanic magnet is used.

The change of polarity is produced simply by soldering to the extremities of the wires which surround the galvanic magnet two small galvanic batteries in such a manner that the vibrations of the magnet itself may immerse them alternately into vessels of diluted acid; care being taken that the batteries are so attached that the current of galvanism from each shall pass around the magnet in an opposite direction.

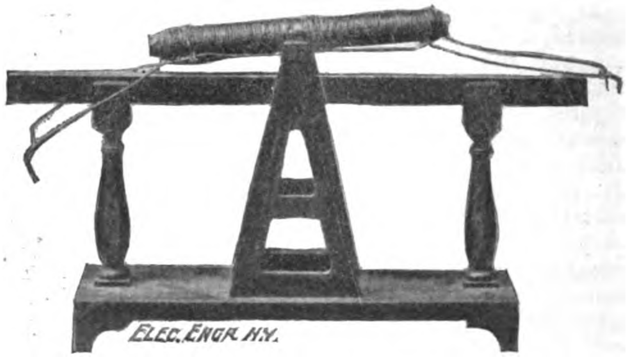
Instead of soldering the batteries to the ends of the wires, and thus causing them at each vibration to be lifted from the acid by the power of the machine, they may be permanently fixed in the vessels, and the galvanic communication formed by the almalgamated ends of the wires dipping into cups of mercury."

If the tumblers be filled with strong diluted acid, the motion is at first very rapid and powerful, but it soon almost entirely ceases. By partially filling the tumblers with weak acid, and occasionally adding a small quantity of fresh acid, a uniform motion, at the rate of seventy-five vibrations in a minute, has been kept up for more than an hour; with a large battery and very weak acid, the motion might be continued for an indefinite length of time.

The motion here described is entirely distinct from that produced by the electro-magnetic combination of wires and magnets; it results directly from the mechanical action of ordinary magnetism: galvanism being only introduced for the purpose of changing the poles.[2]

It is easy to see how motion could be given by this arrangement to a wheel or other mechanical apparatus. "This simple but original device comprised the first automatic pole-changer or commutator ever applied to the galvanic battery—an essential element not merely in every variety of the electro-magnetic machine, but in every variety of magneto-electric apparatus and in every variety of the highly useful induction apparatus."[3]

If Henry could have looked up with pardonable pride to the wires of his telegraph stretched around that upper room in the Academy at Albany, surely he might have regarded with some elation the see-saw motion he had been able to produce and have allowed his imagination to dwell upon the future represented by his machine. The introduction of steam as a motor was an era in the world's history; this use of electricity as a motor was another era; but not for a moment in the enthusiasm of his success was Henry led to believe that the one would supersede the other. He recognized from the first the place of the electro-motor. He considered the source of the power of the machine, namely, the oxidation or burning up of the zinc in the battery; and immediately concluded that the coal required for the preparation of zinc would, if directly applied, give a much greater amount of power at much less expense; but he predicted for his engine a useful and important future in applications where economy is not the consideration. He sums up the question later in these words: "All attempts to substitute electricity or magnetism for coal power must be unsuccessful since these powers tend to an equilibrium, from which they can only be disturbed by the application of another power, which is the equivalent of that which they can subsequently exhibit. They are however, with chemical attractions, etc., of great importance *as intermediate agents in the application of the power of heat as derived from combustion.* Science does not indicate in the slightest degree the possibility of the discovery of a new primary power comparable with that of combustion as exhibited in the burning of coal. We therefore do not hesitate to say that all declarations of the discovery of a new power which is to supersede the use of coal as a motive power, have their origin in ignorance or deception and frequently in both." Mr. Taylor says, "In Henry's deliberate contemplation of his own achievement his remarkable sagacity and propriety of judgment were conspicuously displayed."



The First Electro-Motor.

Henry sent his little machine, as he had his magnets, out into the world, through *Silliman's Journal*. It received, as the magnets had before, an enthusiastic welcome from Sturgeon, who immediately constructed a rotary engine, exhibited in 1833 in London to a large audience. We have here a glimpse of a noble soul: for, when hailed on account of this machine as pioneer in the field, and by an American, Sturgeon took pains to contradict the statement and to give to Henry the priority; worthy of praise, he could not take praise which was not his due. This is especially gratifying since Henry's discoveries were as a general thing taken up and used, as a matter of course, without any reference to himself. In 1834, Davenport of Vermont, an ingenious blacksmith, made a rotary machine; but I may not follow closely the history of the electro-motor; I refer my readers to Mr. F. L. Pope's well known and interesting article upon this subject.[4] The problem of the application of electricity as a universal motive power was taken up with great zeal both in Europe and this country; and contrary to Henry's fundamental and, as time has shown, prophetic conception of the field of the electro-motor, it was everywhere confidently supposed that in time it would supersede steam. In this expectation the misunderstood electro-motor disappointed the hopes reposed in it and for a time it was in disgrace; but, not a success certainly as a prime mover, it has found its place and it is exactly the place to which it was assigned by Henry; it is the assistant of steam, not its rival. Its value lies in its capacity to receive power from a distant source and to transfer it without waste immediately to where it is needed. Mr. Pope says: "Henry accurately foretold the true place, in the domain of industry, of the electric motor. Much confusion of thought exists in the popular mind of the present time in reference to this very point. * * * * Electricity, in its important application to machinery, is never in itself a source of power. It is merely a convenient and easily managed form of energy, by which mechanical power is transferable from an ordinary prime motor, as a steam engine or a water wheel, to a secondary motor which is employed to do the work. It performs an office precisely analogous to that of a belt or line of shafting, which, however useful in conveying power from one point to another, can, under no conceivable circumstances, be capable of originating it."[5]

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[1] The picture given is from a photograph.

[2] Silliman's American Journal of Science, Vol. XX, pp. 342 and 343.

[3] Edward N. Dickerson: "Joseph Henry and the Magnetic Telegraph."

[4] The Electrical Engineer, Jan. 7, 14, 21, 28 and Feb. 4, 1891.

In comparison with other modes of transmitting power the electro-motor is well nigh indifferent to the extent of the distance from the source of its power. Who made the instrument thus indifferent to distance? Let us go back to it as it was in its infancy in 1831, in Henry's cabinet. Henry knew that his magnet, in the telegraph in the upper room, could respond as easily to its battery if that one mile of wire stretched around those walls were extended to hundreds; and he knew as well that his little machine could be made to work if its batteries were equally far away. The means of producing electro-mechanical effects at a distance, this was what Henry had discovered, and in this machine he showed how the power might be used in other ways than in the telegraph.

"In 1834 Dr. Edmonston of Baltimore published a description of the rotary motor, a modification of Henry's arrangement, and these two forms are the prototypes of all the electro-motors, which have been constructed from that day to this."—(Frank. L. Pope.)

Henry's friends urged him, not only to take out patents for his magnets and his telegraph, but also for this machine. Hundreds of patents have been granted in this country for modifications of the electro-magnetic-telegraph, and as many for varieties of the electro-magnetic machine; all of which would have been tributary to Henry as the original patentee. His constant answer to all such solicitations was, "My desire is to add to the sum of human knowledge; what I give, I wish to give freely."

PUBLIC SPIRITED JOURNALISM.

It will be remembered that some time ago the London *Electrical Review* assumed the uphill task of endeavoring to expose the tricks and wiles of "electric belt" quackery, and as a result became involved in lawsuits for libel, which it had the deserved good fortune to win, although as might have been expected, the quacks are still rampant, for the general public rarely reads technical literature and the daily papers persist in printing the quacks' advertisements.

The *Electrical Review* obtained damages, with *Science Siftings*, its colleague in the fight, and Mr. J. Swinburne now has returned to the subscribers to its Defence Fund the entire amount of their subscriptions less a small percentage to cover expenses of printing, stationery, postage, etc. The *Review* is entitled to the congratulations of the electrical profession on its success in this fight, and to admiration for its honorable and public spirited action throughout.

LITERATURE.

Elektrotechniker's Literarisches Auskunftsbüchlein. By F. Schmidt-Hennigker. 2d Edition. Leipzig, 1894. Oskar Leiner. 48 pages. 5½ x 8 inches. Price, 40 cents.

This is an index of the works published in the German language between 1884 and 1893 on the subjects of electrotechnics, electricity, electro-chemistry, magnetism, telegraphy, telephony and lightning protection. The works are indexed alphabetically, by authors and by subjects. Each reference is accompanied by the number of pages, size and place of publication.

Electricity Up to Date. By John B. Verity. London and New York. F. Warne & Co. Paper, 226 pp. illus. Price, 75 cents. (Fourth Edition).

Mr. Verity's useful and handy little book reaches us again, and we can only repeat of this what has been said of previous editions, namely, that it is one of the best of the popular books. There is nothing pedantic about it, yet nothing foolish or inaccurate. It tells the story clearly and plainly, and every page is interesting. Such a book ought to reach its fortieth edition, with constant and careful revision.

Premiers Principes d'Electricité Industrielle. By Paul Janet, Paris, Gauthier-Villars et Fils. 1893. 275 pages, 5½ x 8½. Price $2.

This is a reproduction of a course of lectures delivered by the author at the Faculté Des Sciences of Grenoble, and is intended therefore. more particularly for students. It carries the reader through the study of batteries, including primary, secondary and thermo cells, dynamos and transformers. The book is devoted more to inculcating the principles of these various types of apparatus, giving only such details of construction as to enable the student to form a fair idea of the actual apparatus, all the standard types of which are illustrated. The book is well up to date and the explanations are quite lucid.

Reference Book of Tables and Formulas for Electric Street Railway Engineers. By E. A. Merrill, Author of "Electric Lighting Specifications." New York. The W. J. Johnston Company, Ltd., Flexible Morocco, Pocket Size. Price, $1.

The appearance of this little reference book is very timely as it puts in the hands of the electric railway constructor and superintendent a considerable amount of valuable information. The author has followed the plan of beginning with the steam plant and passing successively through the subject of cars and their equipment, overhead work, track work and miscellaneous tables and formulas. While the works of the best authorities have been consulted, a number of tables and formulas are original, and many others have been modified and extended to adapt them to the conditions imposed in electric street railway work.

Standard Tables for Electric Wiremen, With Instructions for Wiremen and Linemen, Underwriters' Rules, and Useful Formulæ and Data. By Chas. M. Davis. Fourth Edition. Thoroughly revised and edited by W. D. Weaver. Flexible morocco. 128 pages. Price, $1.

This very handy little work has recently received a thorough revision at the hands of Mr. W. D. Weaver, and among the new things embodied in it is the calculation of alternating current wiring. These include tables of alternate current wiring coefficients, those on alternating currents for exterior wiring and on the candle power of arc lamps, and tables enabling those for the three standard lamp voltages to be used for any voltage or drop; as well as several others, including a complete set of wiring tables calculated on a uniform basis of 55 watt lamps. In addition we find a good deal of valuable miscellaneous information in the book.

Dynamo and Motor Building for Amateurs, with Working Drawings. By Lieut. C. D. Parkhurst, U. S. A. New York. The W. J. Johnston Company, Ltd., 1893. 163 pages. 5 x 7 inches. Price. $1.

Although the continued manufacture of electric motors of small sizes has brought their price down much below what it was some years ago, there are still not a few who prefer to gain the practice which only actual work *propriis manibus* can afford. The amateur will find here little or no theory to embarrass him, but straightforward descriptions with diagrams and working drawings, which will enable him to construct three or four kinds of machines, ranging from a small electric motor, driven by battery current, to a 50-light incandescent dynamo. The book has special value as it represents the author's own experience in this class of work, which he has succeeded in laying before the reader in very clear language.

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[5] *Electricity in Daily Life*, Chas. Scribner's Sons, New York, 1891, page 41. (Reprinted from *Scribner's Magazine*.)

Twenty-Fifth Annual Report of the Board of [Massachusetts] *Railroad Commissioners.* (Pub. Doc. No. 14.) January, 1894. Wright & Potter Printing Co., Boston. 8°, pp. xix + 311; Map.

Each succeeding annual report of the Massachusetts Railroad Commissioners devotes an increased amount of space to a discussion of the problems which continually present themselves in connection with the rapid extension of the electric railway service within that commonwealth. While the actual number of street railway companies shows but little increase—in fact, owing to consolidations and other causes, the number reporting is one less than in the preceding year—the aggregate mileage in operation shows, as might be expected, a notable increase. The returns are made up, as usual, to September 30, 1893, at which date, the total length of street railway including double tracks, but not sidings, was 874.14 miles; an increase over the preceding year of 119.29 miles. There has been during the year an increase of mileage operated by electric power of 214.78 miles, and a decrease of mileage operated by horse-power of 95.49 miles. The first successful commercial use of electricity as a motive power in the state is said to have been on the Lynn & Boston line in July, 1888.

The gross assets of all the street railway companies are given as $50,130,278.20, and the gross liabilities as $49,589.687.91. The percentage of surplus to capital stock, which in 1887 was 13.89 fell the following year to 6.82, and has since decreased progressively year by year, until it was in 1893 only 2.09 per cent. A comparison of the traffic returns for the past decade, shows between 1883 and 1893, an increase of 142 per cent. in the passengers carried; of 125 per cent. in number of miles run, and of 96 per cent. in the number of round trips, annually. During the past five years, the average net earnings have increased from $2,420 to $3,810, per mile of railway owned, from 5.56 to 9.65 cents per car-mile run, from 40 to 74 cents per round trip run, and from 0.96 to 1.56 cents per passenger carried.

The average cost of the street-railways of Massachusetts per track-mile, as per books of the companies on September 30, 1893, was for construction, $26,792; for equipment, $15,455.06; and for land, buildings, etc., $11,738.63, making a total average cost per mile of $53,985.69. Of course these figures furnish no basis for estimating, even approximately, the cost of any particular railway. The cost of different lines varies, as returned by the companies, from a minimum of $13,745 to a maximum of $98,907 per mile of track.

These results, for convenience of comparison, have been thrown into a table as follows :—

Earnings and Cost.	In 1888.	In 1893.	Percentage of Increase.
Net Earnings per passenger carried...	$0.96	$1.56	62.50
" " " car mile run........	5.56	9.65	73.56
" " " round trip..........	40.00	74.00	85.00
" " " mile of railway.....	2,420.00	3,810.00	57.44
Cost of railway per mile..............	33,695.00	53,986.00	60.22
Capitalization " "	32,304.00	53,367.00	65.20

Discussing these results, the Commissioners say :—

> The gains which the above table shows in the average net earnings per passenger carried, per mile run and per round trip, ranging from 62 to 85 per cent. in favor of the year 1893, are certainly at first view very striking; and, if these were the only elements in the case, the financial success of the electric system might be pronounced at once to be not only assured, but marvelous. There are, however, other important and decisive factors which must not be overlooked.
>
> In the first place, any increase in the net earnings must obviously be compared with the increase in the cost and capitalization of the electric over the horse system. The manufacturer whose new factory brings him in twice the net income of the old one, has gained nothing in the way of return on his investment, if the new plant has cost him twice as much as the old. So here, the most direct and conclusive test of the net earning capacity of the two systems, is a comparison of the increase in the net earnings per mile of railway with the increase in the cost of the railway per mile. Applying this test, it will be seen that, while the net earnings per mile are 57 per cent. greater, the cost and capitalization per mile are respectively 60 and 65 per cent. greater in 1893 than in 1888,—the odds being clearly in favor of the horse system.
>
> In the second place, it must be taken into account that the electric railways, with their power-stations and electrical equipment, are all of new or recent construction. . . . . For this reason, the cost of the maintenance of the new system, which is chargeable to operating expense, has thus far been abnormally small, and the consequent showing of net earnings from operation has been abnormally large. . . . . The generation and distribution of electric motive power involve extensive plants, costly machinery and intricate apparatus and appliances, all of which must be kept in perfect working order. The wear and tear of roadbed and track are increased by the heavier rolling-stock of the new system. As time goes on, the cost of renewals and repairs cannot but increase or be otherwise than large ; and this cost must go into operating expense. The net earning capacity of the electric system will not, therefore, have been fully tested, until time and experience have demonstrated the normal and full average cost of its maintenance ; and the net results, as they now appear, must be qualified accordingly. . . . .
>
> *We must conclude, therefore, taking everything into the account, that there has been thus far no demonstration of the superior net earning capacity of the electric as compared with the horse system, but rather the reverse.* It is not, however, intended to raise the inference that, the electric system is, or is likely to prove, under conservative and proper management, a serious financial failure. The conditions attending its further and fuller development will probably be found to differ in no essential respect from those attaching to the old horse railway system, or to the steam railroad system. . . . . It can and should be said however, without hesitation or qualification, that the electric system has not shown or indicated any such margin of profit as to justify the expectation of more than moderate and ordinary returns on money legitimately invested in it. The idea, which seems to have obtained some currency, that the electric railway system is a bonanza of rare and inexhaustible wealth is clearly a delusion, and has doubtless proved to some a snare. The absolute cost and expensiveness of the system, under the most conservative, able and honest management, are sufficient to task its earning capacity to the full limit. There is no margin for fictitious or inflated capitalization. It presents no safe or inviting field for speculative enterprise and manipulation, unless it be to the unscrupulous operators of an inside ring who are willing to practice on the credulity of a misinformed public.

The statistics of accidents show that during the year covered by the report, the total number of persons killed and injured by electric cars was 271, being in the ratio of 1 to each 52,475 miles run.

The Commissioners call attention, in very forcible language, to the rapidly increasing number of grade-crossings of electric and steam railroads, the returns for the year showing the appalling increase in these death-traps of from 26 to 100. They say :

> It is not to be believed that the [original] allowance of 100 such crossings outside the public highways would for a moment be thought of. The remarkable condition of things now existing has crept in unawares, as it were, under a code of laws intended only for horse-railway travel, enacted before the operation of street-railways by mechanical power had come to be regarded as more than a remote possibility. Of all the perils which attend travel on railroads and railways in this Commonwealth, there is no one which, in the apprehension of the Board, is so serious, both in its character and extent, as that here pointed out ; and the Board would be derelict in duty to itself and the public, if attention were not again called to it, without waiting for some serious casualty—of the imminence of which, hardly a week passes without giving fresh warning—to emphasize the recommendation.

The Board again call attention to the desirability of legislation limiting the amount of bonds which may be issued by street-railway companies, a recommendation, not acted upon by the last Legislature, but which is obviously quite as much in the interest of all solvent corporations as in that of the investing public, inasmuch as no well-informed person would be likely to invest knowingly in the bonds of any company, with which the market might at any time be flooded to an unlimited extent.

The deductions and observations of so careful and conservative a body of experts as the Massachusetts Commissioners in reference to the questionable profitableness of electric railways as a permanent investment, have not unnaturally given rise to no small amount of comment and criticism. While there is no doubt abundant room for caution in the direction pointed out, and while it must be admitted that there is much reason to fear that as soon as the present financial stringency has in some measure passed away, the extension of electric railways into unprofitable fields may be prosecuted to an extent which cannot but ultimately result in a disastrous collapse, the figures given in the report do not appear to necessarily warrant all the deductions which have been drawn from them. This will appear, for example, from an examination of the comparative results during the same period [1888–93] of a local street railway, with whose affairs the writer happens to be somewhat acquainted, and which has always been justly regarded as an exceptionally well and liberally-managed system. It serves a manufacturing population something in excess of 60,000. In 1888 this system was operated by horse-power and did not extend much beyond the thickly settled parts of the city. Between that date and 1893, the trackage was increased, in round numbers, from 14 to 33 miles ; the system was converted into an electric one ; the capitalization per mile was increased from $22,000 to $30,000 ; the construction account from $11,000 to $18,000, and the equipment account from $5,000 to $10,000. A comparison of net receipts for the same period shows an increase per mile operated of $2,260 to $3,000 ; per round trip of 39 to 58 cents ; per mile run a *decrease* from 8.1 to 6.9 cents, and per passenger carried a *decrease* from 1.4 cents to 1.3 cents. Nevertheless, the company has never once failed, during that time, to pay its regular dividend of 8 per cent., and it has actually a larger surplus to-day than it had in 1888, notwithstanding there has been a trifling increase (from 74 to 75 per cent.) in the ratio of gross expenses to gross income. The falling off in net income, per mile run and per passenger carried, has been caused by the extension of the company's tracks into thinly settled suburban districts, but it is evident that within the next ten years, the increase of population along these suburban routes, will materially augment the gross receipts, without adding in anything like the same proportion to the necessary expenses. It will be contrary to all previous experience, also, if the actual cost, per car mile, of operating an electric railway should not be largely reduced by the progress of science and invention during the same period. This example however, only serves to enforce the moral drawn by the Commissioners, that an electric railway, no less than any other, must be judiciously located and carefully managed, if it is expected to be profitable. F. L. P.

The Lynchburg Electric Company's first mortgage 6 per cent. 25-year gold bonds are offered at par and accrued interest.

LETTERS TO THE EDITOR.

INTRODUCING THE QUADRUPLEX INTO ENGLAND.

MR. W. H. PREECE, C.B., F.R.S., in a paper entitled, "Notes of a Trip to the United States and Chicago, 1893," published in the *Journal of the Institution of Electrical Engineers*, Volume XXIII., No. 109, March, 1894, as the result of an official visit and inspection of the telegraphic system of the United States in 1877, speaks among other things of the practical introduction of the quadruplex system on the Government postal lines. The subscriber hereto is thus reminded of his most delightful visit abroad, the cordial welcome and generous hospitality extended to Mr. George A. Hamilton and himself during their two months sojourn in London and Liverpool having on hand the pleasant and easy task of establishing quadruplex working between the points named.

In view of the openly expressed doubts as to the success of the system abroad, the trial was looked upon as purely in the line of experiment; and predictions were freely made that stormy weather, with the usual accompaniment of a London fog, would prove an effectual barrier to its successful working. It was therefore with considerable pride that from time to time during the first week or two, information was communicated to Mr. Preece of the satisfactory working during weather that proved almost too much for the duplex circuits between London and Liverpool; but these occasions served to indicate what might be expected when the now anxiously looked for London fog should arrive.

The patience of my faithful co-operator at the Liverpool end was soon rewarded by the arrival of a storm from across the Atlantic bringing with it conditions for the development of a veritable London fog which reached a maximum density about 11 a. m. when even the street traffic was rendered somewhat perilous. The service with Liverpool opened rather tardily upon all the regular circuits, the quadruplex being the exception. It was at once supplied with business for all sides owing to the partial suspension of other circuits. At about ten o'clock a. m. the various duplex circuits between the London and Liverpool exchanges and main offices began to fail, and at eleven o'clock the condition of circuits had arrived in which it was deemed useless to attempt further working, and with the various Liverpool files well filled with business awaiting transmission the following memorandum was dropped to Mr. Preece: "11 a. m., Liverpool duplexes all suspended work. Quadruplex working finely four sides."

In less than five minutes Mr. Preece came to the operating room accompanied by Mr. Patey and a sufficient number of the officials from the various departments interested to form a complete circle around the quadruplex table, at which four operators were easily working, two sending and two receiving. Among the group also was Sir William Thomson, whose interest in the exhibition was clearly shown by earnest inquiries respecting details of the service, condition of the line, etc.

The experimental stage having been so successfully passed, the incident above narrated is put on record as part of the heretofore unpublished history of the introduction of multiplex telegraphy abroad; I will simply add thereto the following clipping from the *Telegraphic Journal* of December 1st, 1877, as follows :—

"The quadruplex instruments continue to work excellently well between London and Liverpool. There can be no doubt that the system is a perfect success. Messrs. Gerritt Smith and Hamilton who have so ably superintended the setting up and working of the apparatus have returned to America." GERRITT SMITH.

NEW YORK CITY, April 14, 1894.

DESIGN OF CONSTANT TORQUE VARIABLE SPEED MOTORS.

As a subscriber to the ENGINEER I wish to ask a few questions in regard to a motor intended for variable speeds and such work as requires nearly the full torque or pull at almost any speed. The speed desired is to be widely variable, and yet it is desirable to operate with as little current as possible and as near full voltage at the motor terminals as possible.

How would a series motor with some form of commutated field controller answer the purpose? What would be the average electrical efficiency of such an equipment? Is there a better way than the "commutated field" method of doing this, when one wants in use *but one* motor?

Can you tell me where I can get information in regard to the winding of motors intended for this kind of work, especially the "commutated field" winding? Or can you tell me about the resistance and ampere turns, size of wire of the different sections, number of sections, etc.?

ELWIN C. GREEN.

BUCHANAN, MICH., April, 1894.

[The series motor with commutated field appears to be about the only solution of the problem proposed by our correspondent, unless recourse be had to some form of differential gear whereby the motor may be run at constant speed although the work may be done under variable speed and torque, such as the various epicyclical gears, invented by Henry, Main, Beaumont, and others.

For using only one motor, and where mechanical complication is inadmissible, the only resource is the commutated field series motor. It is impossible to give directions for the winding, without predetermining the characteristic of the machine, by Hopkinson's method or some modification thereof. For this one would need all the data, sizes, proportions, in fact, working drawings, and also the necessary data as to what the motor is intended for, the circumstances and conditions of its use, whether its service is continuous or intermittent, etc. It all depends on how skillfully the magnetic circuit is designed. In a word, the design and proportions involve careful planning and calculation which should be done by a skilled, experienced, and generally competent person. Even then, it is not unlikely that there will be some modifications required in the first machine made, before it is exactly satisfactory. Some information on this subject will be found in papers read before the American Institute of Electrical Engineers, by H. F. Parshall, "Methods of Electrically Controlling Street Cars," April, 1892, and by Geo. D. Shepardson and E. P. Burch, "Electric Railway Motor Tests," June, 1892.

As for the efficiency it will depend largely on the conditions of operation, the relative steadiness and constancy of load, etc. Probably the only conclusive way to determine it is by actual test.

EDS. E. E.]

PATENTS AS ASSETS.

I have read your editorial and those of other journals on the General Electric Co.'s report and note more particularly the reflections on those "ghostly" assets, viz., patents, franchises, etc. I am sure it is not your intention to reflect in any way on the labors of the inventors and electrical engineers, but it seems to me you are doing so in a very pronounced way.

You are aware that the General Electric Co. have acquired property rights in the inventions of Brush, Edison, Thomson and a thousand other inventors of less note who have been mainly instrumental in developing (at an enormous cost) the principal electric arts, which in this country alone are saving the time and adding to the convenience of at least a million inhabitants daily.

Is the laborer worthy of his hire? Do you know of any of them who has been overpaid? Do you think from the knowledge you have of the cost of these developments (which are supposed to be protected by patents) that they and their legal protection have actually cost much less than the amount credited to this asset?

Your idea appears to be that the value placed on those patents is mainly a fictitious one, that they are not worth what they have cost. Mine is, that it is greatly underestimated. Neither of our opinions will amount to anything until the courts of last resort have done their guessing.

One of the journals advises the Company to wipe out the patent asset, stop all litigation, and confine themselves strictly to a manufacturing business. My idea of the theory of anarchism is conveyed in the advice: Don't protect patents but open the gates and let everybody profit at the inventor's expense and labor.

Where would the electrical industries be which we are now enjoying had such policies prevailed during the past twenty years? When you bear on the value of electrical patents you tender discouragement to the electrical engineer.

I hope you will pardon my criticism. I was afraid you had not given the inventor's side due consideration and I hoped to get you thinking in the interest of the inventor. JNO. C. HENRY.

WESTFIELD, N. J.

[An examination of its files will acquit THE ELECTRICAL ENGINEER of any intention, from first to last, to reflect at all on the labors of inventors and electrical engineers. Of course the laborer is worthy of his hire and we should be glad if he were always sure to get it.

How much of the $8,159,000, standing for the value of patents and franchises in the General Electric report, does Mr. Henry think ever reached the pocket of the inventors? EDS. E. E.]

THE STORAGE BATTERY CHALLENGE.

IN reply to the challenge of the Chloride Accumulator Co. we wish to say that there are several reasons why we do not wish to take up that challenge. A fear that our battery, working under the conditions for which it was especially designed, will suffer by comparison with the Chloride accumulator is not one of these reasons. We are ready to supply Mr. Gibbs with all the Donaldson-Macrae batteries he may order at our list price with best trade discount, and would be pleased to have them tested not only by Messrs. Houston and Kennelly, but by everyone in the United States who is interested in storage batteries.

WM. W. DONALDSON, *Pres.*

BALTIMORE, MD., April 6, 1894.

MISCELLANEOUS.

DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.[1]—I.

BY ISAIAH H. FARNHAM.

FOR the past year or more, there have been read befor water, gas and electrical engineering societies all over this country, papers on the subject of electrolytic corrosion of water pipes, gas pipes and lead cables. In fact a meeting of such societies is incomplete to-day without some discussion on this subject. It was, therefore, with hesitation and misgivings, that I considered the written invitation from the officers of the Institute, to prepare a paper on the " Electrolytic effect of currents on subterranean gas and water pipes." A prominent officer of the Institute urged that, as I was undoubtedly the first to discover and satisfactorily prove that this action was destroying cables, I ought to give the society an account of my investigations and the results. On this suggestion, the promise was made to lay before you such facts as opportunity would allow. If sufficient data may be presented to form a nucleus for the evening's discussion, it will, I am sure, be of some practical value.

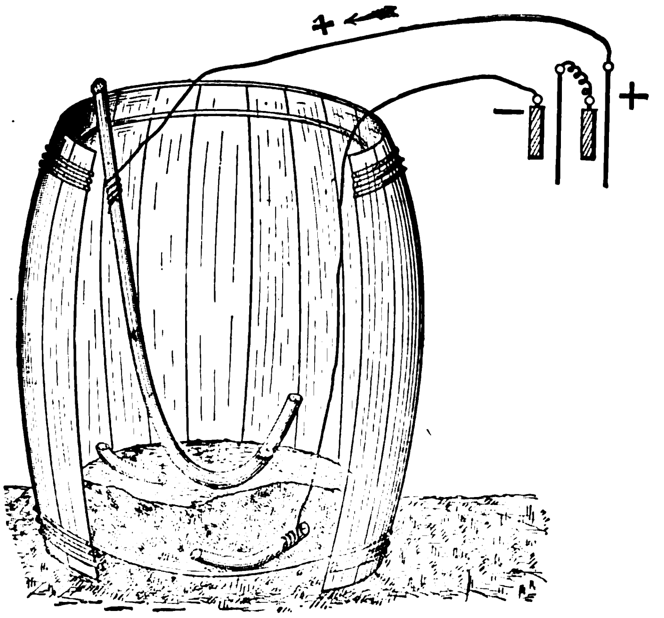

FIG. 1.

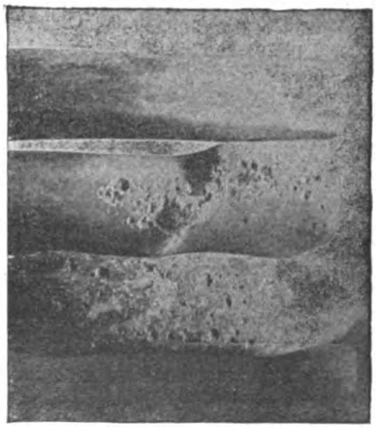

FIG. 2.

Early in the summer of 1891, some lead-covered telephone cable removed from wooden ducts in Boston, showed some very marked yet local spots of corrosion. The cause of the corrosion was generally attributed to acetic acid contained in the wooden conduit, which had, years before, caused corrosion on a few cables in certain sections of the city. In the case just mentioned, the corrosion was so severe, and located in spots only, that it led me to attribute the cause to electrolytic action from the railway currents, and a letter was written to my company to that effect.

A few months later, the lead covering of a cable (No. 208) resting upon the ground in manhole chamber No. 76, located at the corner of Berkeley and Newbury streets, was found eaten entirely through at the point of contact with the earth. I then felt certain that the cable had been destroyed by the action of the current. With Mr. W. X. Towne, my assistant, I proceeded to prove the theory.

We took measurements between the cable and the earth, the cable having been repaired and raised from the ground, and found 1.5 to 2 volts difference of potential, the cable being positive to the earth. A barrel of earth was procured from an excavation in the street, a metal plate placed beneath the earth in the barrel, and two short pieces of lead cable placed side by side on top of the earth. The plate in the bottom of the barrel was then connected to the negative side of a storage battery giving 4 volts potential, and one piece of the cable lying on the earth, was connected with the positive pole of the storage battery. The second piece of cable in the barrel was left without electrical connections. The earth was then saturated with water and the circuit was closed, allowing the current to pass from battery to cable, to earth, to plate and to battery, for seven consecutive days. The pieces of cable were then removed and the piece which had been connected with the battery was badly pitted, closely resembling the cable which had been destroyed, while the second piece of cable showed no corrosion whatever, proving conclusively that a current such as was found in the manhole, was sufficient to cause the damage that had been found, and that the corrosion was not, in the case of the experiment at least, due to any acid or salts in the earth. Fig. 1 shows the barrel experiment, and Fig. 2 is a photograph of the cable No. 208, which has been described as found resting on the earth in the manhole chamber and corroded through; also the pieces experimented upon in the barrel. That shown in the centre of the photograph is cable No. 208.

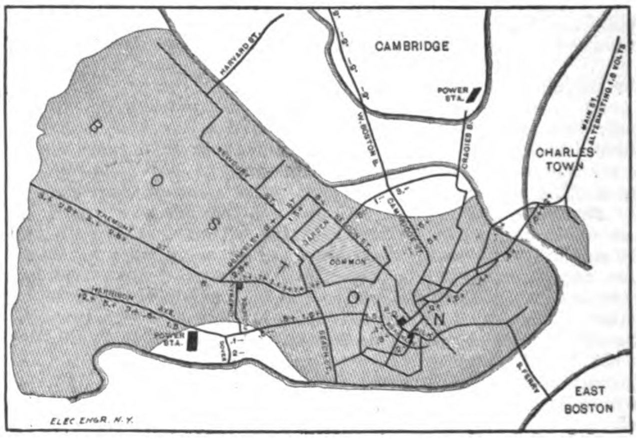

FIG. 3.

In addition to the experiment just mentioned, we placed in the bottom of manhole chamber No. 76, two short pieces of cable, one of which we connected by a wire to cable No. 208, which had been damaged by electrolysis. (It should be understood that the damaged cable had been repaired, and removed from the bottom of the chamber.) At the end of six weeks, the pieces of cable were removed and examined. The one which had been connected with cable No. 208, was deeply pitted,[2] while the other piece was free

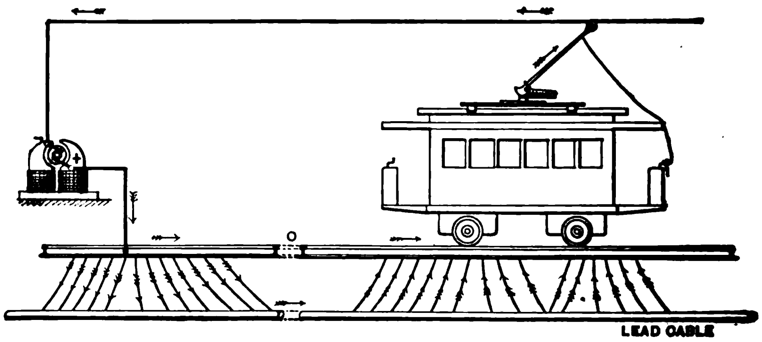

FIG. 4.

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[1] Read before the American Institute of Electrical Engineers, New York, April 18, 1894.

[2] The plumbers of Omaha, Neb., apply the name of " small-pox pipe " to that pitted by electrolysis.

from corrosion. These experiments, with several others of minor importance, satisfied all who were interested, that electrolytic action was destroying cables, and probably gas and water pipes. It next became necessary to prove to the electrician of the railway company, that the current causing electrolysis, was from the railway system and not from a leak in the Edison or some other electric lighting system.

Measurements were made between the cables in all manholes and the earth near the cables, for voltage and direction of current. It was found that within a radius of about 2,000 feet from the Albany street power house, cables were negative to the earth, ranging from zero to 2 volts, and that outside of this neutral line, they were positive to the earth from zero to 12 volts. This condition prevailed until a point was reached near the East Cambridge power house, when they again passed a neutral line and became more and more negative as that power house was approached. The same conditions were found as the Allston Railway power house was approached. On obtaining sufficient data, maps were drawn, showing voltage between cables and earth throughout all sections of the city. This is shown in map, Fig. 3.

In addition to the figures placed beside the several routes of cable conduits, showing the direction of current and its pressure, we have colored red (shaded), each portion of the map where at that time we found the cables positive to the earth. We may call the red portion of the map, the danger territory. These potential measurements, though taken for other purposes, incidentally furnish all the proof needed to convince one that the railway power was the source of the troublesome currents.

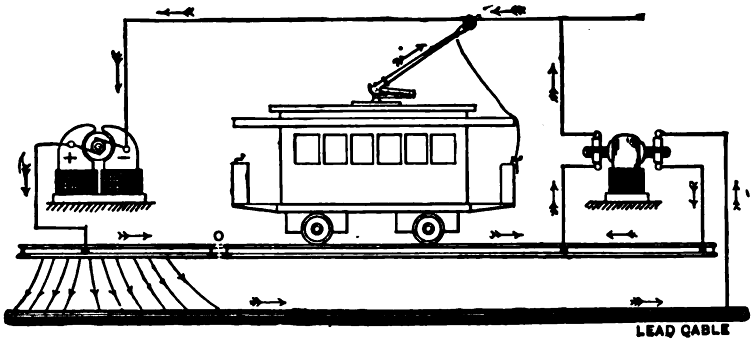

FIG. 5.

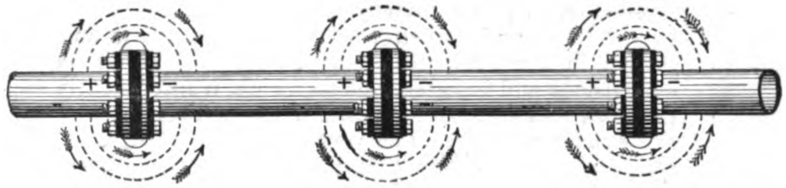

FIG. 6.

At the time the map was made, and previously, the railway was operating with the negative pole of the dynamo to the trolley, the positive side being to the rails. Fig. 4 is intended to illustrate this condition. It shows the passage of current from the dynamo to the rails, and the passage of a portion of the current from the rails to the cables within the neutral or zero line, and from cables to rails outside of this zero line. The danger of electrolysis is only where the current is leaving the cable or pipe through the moist earth, hence the dangerous district was at this time outside of the zero, or neutral line, as shown both on the map (Fig. 3) and in this Fig. 4.

Having outlined our early experience in running down this new trouble, we will now mention some of the proposed and applied remedies. Several conferences were held for the purpose of suggesting and discussing means for preventing the destruction of the cables, at which the officers and experts of both the railway and telephone companies were present, and it should be said, that the railway company in Boston has shown a disposition to adopt any promising plan for overcoming the evil, save, perhaps, the abandonment of the rails and earth as a part of the circuit.

First.—It was proposed to remove all cables from the wet bottom and sides of the so-called manholes. It was found very difficult to place and retain cables free from the wet sides, and even could this have been accomplished, the action at the mouth of the ducts, and within them would still have continued. They were, however, all removed from the bottom of the manholes.

Second.—It was suggested that the cables might be connected to ground plates in the manholes, and so transfer the electrolytic action to these plates, and thus save the cables. This experiment was tried on an extended scale, but though many ground plates having a surface of several square feet each, were connected with the cables over a large portion of the city, it was found that voltmeter readings taken between the cables and a point on the earth a short distance removed from the ground plate in any manhole, gave nearly the same pressure as before the ground plates were connected. In some cases, the voltage between the cables and the earth was reduced 25%; in many others no noticeable reduction was made. The ground plates were constructed from pieces of old lead cable, 6 to 10 feet in length and embedded in the wet earth at the bottom of the manholes. It was evident from this test, that ordinary ground plates would not prove of material advantage for protecting the cables.

Third.—Prof. Elihu Thomson suggested, among other possible remedies, the placing of motor generators at different points along the railway line, wherever the cables and pipes are found to be in danger, the motor generators to be operated by the railway power current; the secondary current developed by these generators to be utilized to lower the potential in the cables and pipes to zero, with respect to the surrounding earth or rails. The suggestion included means for automatically starting and stopping the generators, as cables might become positive or negative to the rails. The motor generators would, so to speak, pump the current out of the cables and force it into the rails whenever the potential of the former should rise above zero. Fig. 5 illustrates this suggestion. This plan has not yet been put into operation so far as I am aware.

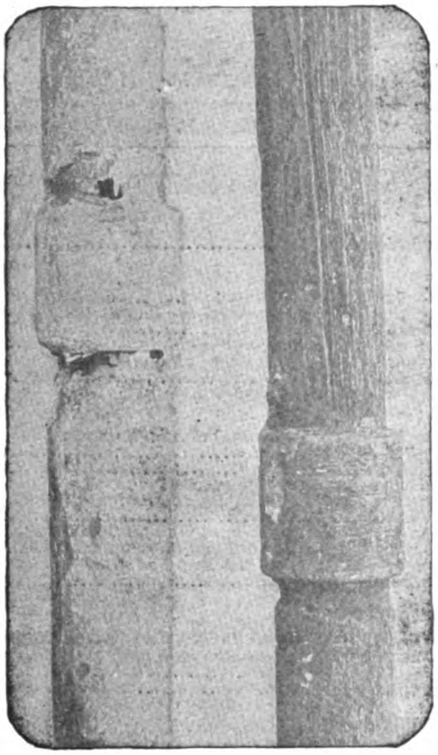

FIG. 7.

Fourth.—Insulating the cables and pipes from the earth was proposed. As some of the worst cases of corrosion of cables by electrolysis occurred where they were painted with asphalt, taped, painted again, and finally covered again with heavy braiding also saturated with asphalt, it was apparent that to insulate cables sufficiently to protect them would be difficult and expensive, if indeed practically possible. To protect water and gas pipes by a sufficient insulating jacket was seen at once to be impracticable.

Fifth.—Breaking the metallic continuity of the cable sheath and pipes was proposed. From the fact that severe action is frequently found in comparatively isolated spots, where cables and pipes cross each other or pass near or across the rails, it follows that any system of breaking the metallic continuity, would have to be studied with reference to the entire complicated system of pipes, cables and rails ramifying through the streets of a city. There would also be a difference of potential between the several sections of cable or pipe, severed metallically, tending to cause electrolysis at one end of each section, as illustrated in Fig. 6. In case of water pipes, treated in this manner, the action might be expected on the interior as well as on the exterior.

There appears to be some evidence of such an action as this in gas and water pipes where the electrical continuity is partially

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3360 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies, - - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

VOL. XVII. NEW YORK, APRIL 25, 1894. No. 312.

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RAILWAYS AND ELECTROLYSIS.

It may be deemed a reflection upon the pioneers in electric railroading to say that if they had known of the difficulties and obstacles,—electrical, mechanical and those due to prejudice,—which have had to be overcome, they might have hesitated before entering upon their work. We have passed through periods when the gearing absorbed almost the entire attention of electric railway engineers, and, within a recent period, methods of car regulation have undergone radical changes. It is perhaps fair to assume that both on the car and in the station a condition of greater stability in practice has been reached, but a calm survey of the whole field after ten years of electric railroading reveals the fact that there are conditions existing which require the gravest consideration and remedy, if the present simple and economical methods of operation are to be maintained. We refer to the action of railway currents on water and gas pipes as well as upon other conductors buried in the earth which forms the return for the railway current. There was a time when the possibility of this action was denied, but the enormous and increasing evidence of its actuality can now no longer be successfully controverted. It therefore rests upon street railway companies to seek by all powers within their means to remedy the evils complained of, and as the first step to be taken by those who have not already made some attempts in this direction we would earnestly recommend the careful study of the paper read by Mr. I. H. Farnham before the American Institute of Electrical Engineers, and appearing elsewhere in this issue. Himself the first to call attention to the danger from electrolysis, Mr. Farnham has had the grim satisfaction of seeing his predictions verified in the most complete manner. Not stopping here, however, he has earnestly worked, in conjunction with others likewise interested, to find a remedy for the evil. The exhaustive experiments undertaken with this end in view and embodied in Mr. Farnham's paper, have led to a number of conclusions and suggested plans which, if intelligently carried out, will largely mitigate, if not entirely remove the evil existing to-day. The re-enforcing of the ground return by heavy conductors attached to the pipes in the affected territory appears to be one of the simplest as well as the most logical ways out of the difficulty. While there can scarcely be two opinions as to the efficacy of this broad remedy for the evil there appears to be still some difference of opinion on a minor point in its application relating to the polarity of the trolley and earth, respectively. As Mr. Farnham points out and as his tests prove conclusively, the connection of the positive pole to the dynamo serves to concentrate the electrolytic action to the pipes in the immediate vicinity of the power station.

But arguments have been advanced in favor of the opposite method of connection and during the discussion of the paper Mr. A. E. Kennelly expressed the belief, based on calculations, that it might be found more advantageous to spread the action over a larger territory and thus diminish its intensity proportionately, than to concentrate it at any one point which must of necessity be subjected to more intense action and therefore more rapid deterioration. These are points, however, which time and experiment will solve. In the meantime it is gratifying to know that we can now avail ourselves of an efficient method for overcoming a most insidious evil which for a time seriously threatened the life of the trolley railway. Mr. Farnham's paper also touches closely on the question of the minimum E. M. F. required to effect electrolysis, and since writing his paper he has finished some very careful tests on this point. The thanks of the entire profession and industry are due to Mr. Farnham for his timely and exhaustive paper, which will help to clear up many doubts.

(*Continued from page* 373.)

broken by leaded joints. Fig. 7 shows an iron service pipe from the Cambridge gas system. It will be noticed that the action is most severe at points immediately on either side of the coupling. The reason of the corrosion appearing on both sides of the coupling in this case is not clear; it may be due to reversal of current on the railway system. We have observed other specimens similar to this, which may tend to show that for currents of low pressure, the resistance of joints materially affects the results. I will again refer to this question in connection with potential differences in water mains.

Sixth.—My assistant, Mr. Towne, suggested that the railway current might be so frequently alternated as possibly to prevent serious action on the pipes and cables. The theory was, that before the oxygen gas, liberated by the current, should have time to attack the metal, the reversal of the current would disperse it. A careful experiment was conducted, extending over a period of ten days, employing a pressure of current of from three to seven volts and alternating its direction at regular periods of one minute, by specially devised apparatus. No material change had taken place in either plate during this period of time. We then considered the practicability of reversing the railway current frequently. It seemed possible to reverse it once each 24 hours, at a given time in the night when the load is comparatively light. To do this in a large system involving several power stations would require either a loss of current for a few minutes in order to guard against one station reversing before some other had opened or reversed its current, or would require some electrical system connecting the several stations together and operating the reversing apparatus simultaneously. We concluded it would be very difficult, if indeed at all practicable, to reverse such heavy currents during regular traffic. We then renewed the reversing experiment, giving 24 hour periods between each alternation, but found at the end of two weeks, to our sorrow, that the plates subjected to the action of the current were seriously electrolyzed. It seemed useless to pursue this line of work further at that time. When alternating current motors become practicable for use on street cars, advantage may be taken of the fact that such currents appear not to cause electrolysis to the extent of injuring pipes and cables exposed to them.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTICAL ENGINEERS.

The 86th meeting of the Institute was held at 12 West 31st street, New York City, April 18, President Houston in the chair. The Secretary announced the death of Dr. Franz Schulze-Berge at Brooklyn, on March 21, and stated that an appropriate obituary notice would be printed in the *Transactions*.

Upon recommendation of the Committee on Units and Standards, an informal vote was taken expressing the sense of the meeting as favorable to the passage of a bill by the United States Congress, legalizing the electrical units adopted by the Electrical Congress of 1893 at Chicago.

The paper of the evening was read by Mr. I. H. Farnham, of Boston, on the "Destructive Effect of Electrical Currents on Subterranean Metal Pipes," and was profusely illustrated with lantern slides. The final views showing the electrolytic action of the current, were watched with great interest by an audience of over 100. The discussion was opened by Prof. Plympton, of Brooklyn, and participated in by Messrs. Kennelly, Emery, Waldo, Houston and others. A communication upon the subject was also read from Mr. Lockwood. Other communications from Prof. Thomson and Mr. Lemp were received too late to be read at the meeting. The slides used have been sent to Mr. A. V. Abbott at Chicago, who will represent the author at a meeting of the Western members to be held at the Armour Institute, April 25.

At the meeting of Council in the afternoon, the following Associate Members were elected :—

Best, A. T., Electrical Engineer, Hotel Ponce de Leon, Florida; Carus-Wilson, Charles A., Professor of Electrical Engineering, McGill University, Montreal, P. Q.; Colvin, Frank R., Treasurer and Business Manager, THE ELECTRICAL ENGINEER, 203 Broadway, New York City; George, John C., President, Raleigh Electric Street Railway Co., Marine Bank Building, Baltimore, Md.; Gerry, James H., Superintendent, The Self-Winding Clock Co., 163 Grand Ave.; Gladstone, James Wm., Manager, Edison Mfg. Co., West Orange, N. J.; Hobart, Henry M., Engineer, General Electric Co., Schenectady, N. Y.; Hood, Ralph O., Electrical Engineer, with General Electric Co., 180 Summer St., Boston, Mass.; Hubbard, William C., Electrician, Royal Arc Electric Co., 143 Liberty St., New York City; Ingold, Eugene, Consulting Engineer and Expert, Pittsburgh, Pa.; Keefer, Edwin S., Supt. of Electric Light Construction, Western Electric Co., 22 Thames St., New York City; Macloskie, Chas. H., Engineer, with B. J. Arnold, 436 The Rookery, Chicago, Ill.; Neiler, Samuel G., Ass't Electrical Engineer, The World's Columbian Exposition, 4,318 Berkley Ave., Chicago, Ill.; Proctor, Thos. L., General Manager, Riker Electric Motor Co., Newtown, L. I., N. Y.; Searles, A. L., Engineering Dept., The Royal Arc Electric Co., 78 Watt St., New York City; Toerring, C. J., Jr., Electrician, Royal Arc Electric Co., 143 Liberty St., New York City; Wiley, Walter S., Supt. South Omaha Electric Light Co., South Omaha, Neb. Total 17.

The following Associate Members were transferred to Full Membership upon the recommendation of the Board of Examiners:—

Greene, S. Dana, Assistant General Manager, General Electric Co., Schenectady, N. Y.; Eickemeyer, Rudolf, President Eickemeyer and Osterheld Manufacturing Co., Yonkers, N. Y.; Morrow, John Thomas, Supt. Electrolytic Plant, Boston and Montana Consolidated Copper and Silver Mining Co., Great Falls, Mont.; Johnston, A. Langstaff, Consulting Engineer, Hestonville, Mantua and Fairmount Passenger R. R. Co., 4,800 Lancaster Ave., Philadelphia, Pa.; Crandall, Joseph Edwin, Electrician, C. & P. Telephone Co., 619 Fourteenth St., N. W. Washington, D. C.

Mr. Elmer G. Willyoung, Chairman of the Local Committee at Philadelphia, who was present, informed the secretary that active preparations were being made in that city, for the coming Annual and General Meeting of the Institute, May 15th, 16th and 17th. The Engineers' Club has offered to throw open its House for the use of the Institute and it is proposed to make the Bingham House the Headquarters. The first meeting of the Institute after its organization was held in Philadelphia in 1884 and its return to the Quaker City is an appropriate celebration of its Tenth Anniversary, marking as it does the close of the year showing the largest growth in membership since its foundation.

The Annual Meeting will be held in the afternoon of May 15th. At this session the results of the election of officers will be announced and the reports of the Council and Treasurer read. Other matters to be brought up will probably be the revision of the election rules and recommendations of the Committee on Units and Standards. The Annual Dinner of the Institute will occur in the evening. Wednesday and Thursday will be devoted to the reading and discussion of papers, the still incomplete list reported by the Committee being as follows :—

Discriminating Lightning Arresters, and Recent Progress in Means for Protection against Lightning.
Alexander Jay Wurts.

The Law of Hysteresis (Part III) and The Calculation of Ferric Inductances. Charles P. Steinmetz.

Alternating Currents and Fuse Wires.
Dugald C. Jackson and R. J. Ochsner.

The Waste of Zinc in Open Circuit Batteries when Standing Idle. Henry A. Lardner.

Some Storage Battery Phenomena. W. E. Griscom.

Central Station Economy. C. Reginald Van Trump.

A Review of the Progress of the American Institute of Electrical Engineers. Edwin J. Houston.

Standardizing Electrical Measuring Instruments.
(a) By the Potentiometer Method.
(b) An Improved Direct Reading Potentiometer.
Elmer G. Willyoung.

Experiments with Two-Phase Motors. Louis Duncan.

A Test of a Closed-Coil Arc Dynamo. R. B. Owens.

Test for Closed Coil Arc Dynamo.
Prof. R. B. Owens, of Lincoln, Neb.

Relative Advantages of Toothed and Smooth-Core Armatures.
Mr. Alton D. Adams, of Worcester, Mass.

Resonance Analysis of Alternating and Polyphase Currents.
Prof. M. I. Pupin, Columbia College, New York.

Unipolar Dynamos for Electric Lighting.
Prof. F. B. Crocker, Columbia College, New York.

The local Committee has in view various plans for the entertainment of the visiting engineers.

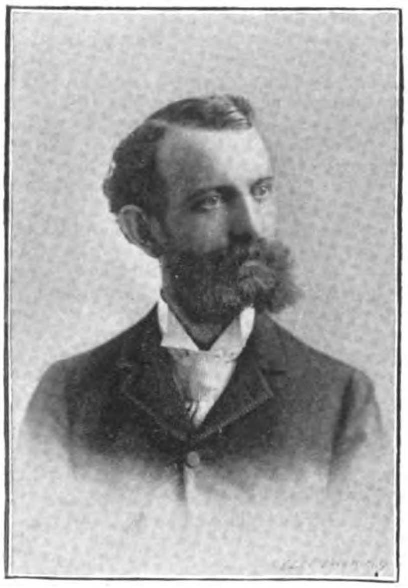
A NEW ELECTRICAL SOCIETY IN BOSTON: "THE ELECTRIC POTENTIALS."

ABOUT a month ago there was held in Young's Hotel, Boston, a dinner, at which were present a number of members of the old Boston Electric Club, and other gentlemen interested in the electrical profession. It was the general opinion at that time that some kind of an electrical association should be formed in Boston, and another dinner was given on Friday night of last week with Mr. W. J. Denver in the chair, on which occasion the resolutions passed at the previous dinner took definite shape. It was voted after considerable discussion to call the society "The Electric Potentials," and that dinners should be held quarterly, on which occasions it should be the endeavor of the society to provide also a paper by a member or friend on some subject interesting to the electrical profession. The following officers were then elected: C. W. Holtzer, president; Frank Ridlon and E. H. Hewins, vice-presidents; I. H. Farnham, treasurer and A. C. Shaw, secretary. About twenty-five gentlemen were present, and the following became members at once: W. J. Denver, E. H. Hewins, S. G.

Stiness, Frank Ridlon, W. D. Warner, C. W. Holtzer, B. S. Flanders, A. C. Shaw, C. W. Gates, I. H. Farnham, I. O. Wright, W. S. Hill, G. W. Adams, R. A. Ripley, H. G. Tuckerman, J. M. Orford, F. S. Palmer, Capt. Wm. Brophy, R. F. Ross, G. M. Angier, A. T. Clark, and H. H. Brooks. The initiation fee is $2, and the annual dues $1, and it was the universal opinion of the gentlemen present, that an association formed in this way, without any headquarters, and with only nominal expense would be successful, of much use, and would enable the members of the electrical profession in Boston to spend many agreeable social evenings.

PERSONAL.

ISAIAH H. FARNHAM.



Isaiah H. Farnham.

MR. I. H. FARNHAM was born in Woolwich, Me., in 1853. At an early age his natural love for mechanics manifested itself in his production of numerous models of steam engines and telegraph apparatus. At the time of the introduction of the telephone Mr. Farnham was in the employ of the Western Union Telegraph Co. and was immediately transferred to the telephone department of that company. At Portland, Me., where Mr. Farnham served as superintendent the telephone became very popular and that city held the record for many years for the largest number of telephones per capita of any city in the world.

In 1885 Mr. Farnham became the electrical engineer of the New England Telephone & Telegraph Company and removed his office to Boston. Since that time all electrical work of that company has been under his supervision.

Early in 1891 Mr. Farnham suggested to his associates throughout the country that the general introduction of trolley systems in our cities might, unless precautions were taken, lead to serious trouble among all metallic underground structures. Mr. Farnham's suggestions were not appreciated by the electrical fraternity and it was not until a most careful and scientific series of experiments had been conducted by him that he convinced them of its seriousness.

During his successful career Mr. Farnham has been the patentee of over a score of electrical inventions covering broadly the whole field of telephony, many of them being, in their particular branch, of a fundamental character. Mr. Farnham has been a member of most of the "Telephone Conferences" and is now a member of the standing committee on switchboards.

The subject of this sketch is a man of studious habits and of extreme modesty. The interest which he has taken in the welfare of his subordinates together with the uniform courtesy and frankness with which he has met his associates has built up for him a host of friends in all branches of the profession.

MR. NIKOLA TESLA has been awarded the Elliott-Cresson Medal by the Franklin Institute, of Philadelphia, for his Researches in High Frequency Phenomena.

LEGAL NOTES.

ADAMS ELECTRIC RY. CO. *vs.* LINDELL ELECTRIC RY. CO.—ELECTRIC MOTOR LITIGATION.

The lawsuit brought under the patents of Dr. Wellington Adams, and pertaining to the relation between motor under the car and the axles came to a hearing at St. Louis last week, in the U. S. Circuit Court, the case being defended by the General Electric Co. The details have already been given more than once in our columns.

Messrs. Upton, Campbell, Fowler & Fowler, of St. Louis, and R. H. Parkinson, of Chicago, appeared for the plaintiff, and Messrs. Betts, Hyde & Betts, of New York, for the defendants. Dr. Adams made the preliminary statement of the case for the complainant company. The proceedings are before Judge Hallett.

INCANDESCENT LAMP LITIGATION.—EDISON ELECTRIC LIGHT CO. *vs.* BOSTON INCANDESCENT LAMP CO.

U. S. CIRCUIT COURT, Colt, *J.*—A motion was made last week by the Edison Electric Light Company to grant them an injunction against the Boston Incandescent Lamp Co. Decision waived. Messrs. Fish, Richardson and Storrow appeared for the plaintiffs; John Lowell and John Lowell, Jr., the defendants.

INTERIOR WIRING LITIGATION.—INTERIOR CONDUIT AND INSULATION CO. *vs.* EUREKA ELECTRIC CO.

A decision has been filed by Judge Coxe in the U. S. Circuit Court for the Southern District of N. Y. dismissing a bill of complaint on U. S. patent No. 401,498, granted to Johnson and Greenfield April 16, 1889 for Improvements in Wiring Structures for Electric Lighting, relating to twin conductors in a single tube. R. N. Dyer and D. H. Driscoll for complainant. Francis Forbes and C. E. Mitchell for defendant. The opinion is long. Its main features are as follows: It states that the combination of the claims is limited to "1st. A pipe of insulating material. 2d. A pair of wires insulated from each other and placed in close proximity to each other within said pipe, and each forming one side of an electric lighting circuit. 3d. A safety catch interpolated within said circuit." Also that "the complainant's brief contends 'that each of the elements of the combination claimed in claims 1 and 3 was old.'" Judge Coxe then reviews the state of the art and says: "Enough has been said to demonstrate the proposition that this patent rests upon an exceedingly vague and shadowy foundation." * * "I have examined the patent with care to discover what new idea it has contributed to the art and am compelled to think that the art of electric lighting would have lost nothing tangible if the statements of the patent had never been made public. I cannot resist the conclusion that many of the marvelous attributes ascribed to the patent are after-thoughts which find their origin largely in ardent and ingenious expert imagination. It may be doubted whether the patentees themselves were conscious when they put the old wires in the old pipes, that they had made a discovery which cured all the defects of the past and was to lay a heavy tribute upon all the electric wiring in the future." The suit was defended by the New York Insulated Wire Co.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 10, 1894.

Alarms and Signals:—

Electrical Annunciator, R. L. Hunter, St. Paul, Minn., 518,037. Filed Feb. 13, 1893.

Dynamos and Motors:—

Electric Power Appliance, B. J. Arnold, Chicago, Ill., 517,831. Filed Aug. 31, 1892.

Employs a series of dynamos with switches so that any one may be connected with conductors as a motor or a generator, a driving shaft and a lock to connect the rotating part of the machine directly with the shaft when the two have attained equal speed, and a magnetic device to operate the lock.

Electric Motor, E. T. Greenfield, New York, 517,858. Filed Oct. 1, 1891.

Employs a series of arc shaped solenoids having an annular core of alternate sections of magnetic and non-magnetic material, a centreing device for the core, a power transmitting device driven by the core and brushes carried by the solenoids and making contact with the core.

Governor for Electric or Other Motors, N. S. Keith, San Francisco, Cal., 517-866. Filed July 5, 1893.

Consists of a dynamo whose armature is driven by the motor, steam-engine, windmill, water wheel or other device to be regulated, and whose field magnet is rotatable in one direction by the magnetic torque of its armature and in the other direction by a spring.

Electric Motor, J. C. Henry, New York, 518,033. Filed Sept. 27, 1889.

Employs a laminated armature core composed of segments having circumferential projections and being arranged to break joints so that the projections on each segment shall lie opposite open spaces on the adjacent segments.

Speed and Power Regulator for Motors, H. B. Gale, San Francisco, Cal., 518,062. Filed June 21, 1893.

Employs a secondary battery whose poles are connected to the corresponding poles of the armature, and power transmitting devices connecting the motor with a dynamo which acts alternately as a generator to charge the battery and as an auxiliary motor driven from the battery, and absorbing any surplus energy generated by the prime mover.

Lamps and Appurtenances:—

Electric Incandescent Lamp, J. E. Origgal, Springfield, Mass., 518,179. Filed Dec. 8, 1893.

Employs two glass tubes for the leading-in wires open from end to end and having their inner ends closed by a filling of plastic material, a quantity of mercury in the tube above said material and another plastic filling at the outer end of the tubes.

Adjustable Electrolier, C. M. McCamey & S. H. Root, Longmont, Col., 518,193. Filed Dec. 5, 1893.

Miscellaneous:—

Electrical Foot Bath, I. A. Isaacs, New York, 517,862. Filed Jan. 10, 1894.

Mode of Connecting Dynamos to Car Axles, W. Biddle & P. Kennedy, Brooklyn, N. Y., 517,997. Filed July 3, 1893.

Electric Car Lighting System, W. Biddle & P. Kennedy, Brooklyn, N. Y., 517,998. Filed April 20, 1893.

Relates to the manner of supporting and actuating the dynamo, and to automatic devices for changing the circuit connection when the direction of rotation of the dynamo is varied by the change of direction of the car; and also provides for preventing the accumulator from discharging through the dynamo when the latter slows down or stops.

Electrolytical Apparatus, C. Hoepfner, Giessen, Germany, 518,065. Filed Feb. 8, 1892.

Permanent Magnet, A. T. Collier, St. Albans, Eng., 518,092. Filed Jan. 8, 1894.

Claim.—A magnet consisting of a bar or bars formed as a loop or coil having the ends crossing each other and both extending inward toward the interior of the loop or coil to constitute two poles.

Electrolytic Apparatus, H. Y. Castner, London, Eng., 518,135. Filed June 8, 1893.

Railways and Appliances:—

Rail Connection, T. C. Paulsen, Chicago, Ill., 517,884. Filed Dec. 29, 1893.

Employs metal caps upon the ends of the rail bond adapted to be driven into holes through the flange of the rail.

Electric Railway, H. S. Pruyn, Hoosick Falls, N. Y., 517,886. Filed Nov. 1, 1893.

A conduit railway system employing insulators supporting a sectional conductor and being constructed so as to be freely removable from their mountings so that one or more sections of the conductor may be bodily removed from the conduit.

Electric Railway System, C. D. Tisdale, Boston, Mass., 517,940. Filed Jan. 17, 1893.

Employs the two sectional rails of the track, the one as a positive and the other as a negative conductor, and a truck provided with two paper wheels and two iron wheels placed diagonally opposite so that contact is made through the two metallic wheels at points of the rails not opposite one another.

Method of and Means for Speed Regulation of Electric Locomotives, C. E. Emery, Brooklyn, N. Y., 517,948. Filed Oct. 14, 1892.

Provides a number of motors which will develop different counter-electromotive forces at like speeds of the car.

Electric Locomotive, W. Lawrence, New York, 518,006. Filed Jan. 21, 1893.

Employs a commutator having contacts adapted to engage forked brushes and means for moving either of the brushes into engagement with the contacts.

Ice Cutting Trolley, R. W. Thompson, Cleveland, O., 518,015. Filed Nov. 4, 1893.

Consists of a centrally perforated hub provided with a grooved disc and concentric peripheral rings completing the sides of the groove.

Trolley Wire Insulator, L. McCarthy, Boston, Mass., 518,071. Filed June 8, 1893.

Switches and Cut-Outs:—

Electric Switch, A. T. McCoy, Boston, Mass., 517,957. Filed Apl. 13, 1893.

Employs two levers upon the same pivot, one of which is provided with prongs projecting at right angles and adapted to move the other lever against the tension of the spring.

Electrical Contact Mechanism, J. F. Blake, New Haven, Conn., 518,133. Filed Jan. 25, 1894.

Consists of a pivoted arm provided with an insulating portion and separated conducting strips to which terminals are connected; a rolling contact traveling on the arm and connecting the conducting strips, and a spring having a jointed connection with the arm for operating the latter.

Circuit Switch, E. E. Hersh, B. F. Woodward & J. W. Pettee, Denver, Col., 518,188. Filed Oct. 25, 1893.

Has for its object especially to cheapen and simplify the construction of the class of devices to which it relates.

Telephones and Apparatus:—

Telephone Transmitter, J. & H. M. Goodman, Louisville, Ky., 518,142. Filed Aug. 19, 1893.

Consists of two magnets placed in a straight line end to end and a mass of pulverized metal susceptible of magnetic induction between the ends of the magnets, in combination with a vibrating diaphragm mechanically connected with the extremity of one of the magnets, and an electrical condenser.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 17, 1894.

Alarms and Signals:—

Electric Railway Signal, B. F. Rex, St. Louis, Mo., 518,511. Filed March 4, 1892.

An automatic electric block system for steam railways.

Automatic Electric Signaling Device for Crossings, E. A. Hermann, St. Louis, Mo., 518,525. Filed Sept. 25, 1893.

Conductors, Conduits and Insulators:—

Insulating Turnbuckle, H. P. Ball, Schenectady, N. Y., 518,213. Filed Dec. 22, 1893.

Ceiling Cleat, H. P. Ball, Bridgeport, Conn., 518,214. Filed Jan. 12, 1894.

Ceiling Cleat, H. C. Wirt, Boston, Mass., 518,301. Filed Oct. 27, 1893.

Strain Insulator, L. McCarthy, Boston, Mass., 518,373. Filed Jan. 15, 1894.

Dynamos and Motors:—

Means for Exciting Field Magnets of Alternating Current Dynamos, L. Bell, Boston, Mass., 518,217. Filed Nov. 17, 1893.

Claim 1 follows:—

In combination, alternating current dynamos, having their field magnet coils connected to bus-bars, and motor generators actuated by alternating current and delivering continuous current to the bus-bars.

Regulator for Dynamo Electric Machines, L. Bell, Boston, Mass., 518,218. Filed Nov. 28, 1893.

Employs an amperemeter having a movable scale, a rheostat, and means whereby the movement of the rheostat arm actuates the scale of the amperemeter.

Regulator for Dynamo Electric Machines, W. H. Elkins, Cambridge, Mass., 518,232. Filed Jan. 3, 1893.

The invention consists in providing double pairs of contacts for the armature of the controlling maget, the circuit through one of which shunts the motor magnet with very small resistance while the others also shunt the motor magnet, but through a considerably greater resistance.

Armature for Dynamo Electric Machines, E. Thomson, Swampscott, Mass., 518,290. Filed Jan. 19, 1892.

Relates to certain mechanical details of construction.

Mode of Cooling Electric Motors, E. Thomson, Swampscott, Mass., 518,291. Filed Nov. 30, 1892.

Employs a closed casing for the motor provided with projecting studs to increase its radiating surface, a pipe communicating with the casing and a water jacket surrounding a portion of the pipe.

Universal Phase Alternate Current Motor, T. Duncan, Fort Wayne, Ind., 518,310. Filed May 22, 1893.

Claim 3 follows:

The combination in an electro-magnetic motor for single or multiphase alternating currents, of a field magnet adapted to be connected with said currents, a closed rotary armature, a magnetic path diverter and the adjusting lever.

Armature, E. Egger and F. A. Wessel, New York, 518,312. Filed May 17, 1893.

Consists of a core having grooves, insulated iron plates fitting in said grooves, and conductors wound between the plates and on the core.

Controller for Electric Motors, W. Cooper, Minneapolis, Minn., 518,345. Filed Aug. 28, 1893.

Provides for arranging the motors in series in an open circuit, inserting a total resistance, gradually cutting out a part of the resistance, opening the circuit and coupling the motors in multiple arc, and afterward reinstating the remainder of said resistance and gradually cutting it out.

Regulator for Dynamo-Electric Machines, C. L. F. Muller, Deceased, Milwaukee, Wis.; C. R. Carstens, Administrator, Milwaukee, Wis., 518,349. Filed May 13, 1889.

Provides means for regulating the strength of the working current by excluding from activity the coils of the armature supplying the exciting current for part of their angular movement; and to provide working currents of different degrees of quantity or intensity by variously coupling the coils of the armature.

Electric Current Regulator, A. G. Waterhouse, Hartford, Conn., 518,359. Filed Nov. 26, 1892.

Employs one or more electrolytic cells in combination with one or more current generators, the counter electromotive force of the former being approximately equal to that of the latter.

Method of Regulating Electric Currents, A. G. Waterhouse, Hartford, Conn., 518,360. Filed Apl. 13, 1892.

Similar in its object to No. 518,359.

Dynamo Electric Machine, H. E. Dikemann, Berkeley, Cal., 518,444. Filed Feb. 13, 1894.

Employs rotating inner and outer poles, the former having exterior extensions forming the axles of rotation, and the adjacent edges of the outer pole being connected together.

Electric Motor, H. P. Brown, New York, 518,561. Filed Jan. 26, 1893.

Employs an armature having a core composed of a series of thin soft iron rings in combination with asbestos or mica insulating plates placed between some of the rings but not between all of them.

Armature for Electric Motors, H. P. Brown, New York, 518,562. Filed Feb. 6, 1893.

Employs a commutator having an annular space between the shaft and the segments containing burned shellac.

Measurement:—

Cut-Out Meter, C. D. Haskins, Lynn, Mass., 518,244. Filed Sept. 19, 1892.

Comprises a meter and a switch held closed by a detent but adapted to be released by the closing of an electric circuit by the meter after any predetermined amount of current has passed.

Damping Device for Electrical Measuring Instruments, F. Holden, Lynn, Mass., 518,245. Filed Mch. 3, 1893.

Consists of a hermetically sealed chamber having a plain inner surface and inclosing a viscous liquid.

Electric Measuring Instrument for Multiphase Systems, E. W. Mix, Lynn, Mass., 518,265. Filed Mch. 21, 1892.

The invention includes broadly the application of a rotary magnetic field produced by non-coincident coils in the several circuits in order to produce in an armature acted upon by said fields a torque dependent upon the currents in the several circuits.

Electric Meter, T. Duncan, Fort Wayne, Ind., 518,311. Filed Aug. 2, 1893.

A recording watt meter employing a high resistance shunted around the terminals of the armature in lieu of a condenser, which also eliminates sparking by forming a discharge circuit when the armature circuit is open.

Electric Current Recorder, J. W. T. Olán, New York, 518,534. Filed July 7, 1893.

Has for its object to provide means for recording and indicating the quantity as well as the tension of a certain current so that the whole of Ohm's law will be determined.

Miscellaneous:—

Electric Tower Clock, C. D. Warner, Ansonia, Conn., 518,337. Filed April 6, 1893.

Thermo-Electric Generator, H. B. Cox, Hartford, Conn., 518,542. Filed April 28, 1893.

A thermopile having the ends of the couples coated with hardened fireproof material and provided with metal jackets.

Method of and Apparatus for Amalgamating Ores, H. F. Edwards, Butte, Mont., 518,543. Filed March 17, 1893.

Railways and Appliances:—

Electric-Motor Car, H. P. Brown, New York, 518,221. Filed Dec. 21, 1891.

Employs an electric motor having field magnets furnished with both series field coils and shunt field coils, and a choking magnet adapted to be placed in connection with the series field in starting the motor.

Controller for Electric Railway Cars, W. H. Knight, Lynn, Mass., 518,254. Filed Dec. 21, 1893.

Employs means of actuating the controller from source of fluid pressure carried on the car and an indicator upon the platform to show the conditions of the controller.

Electric Railway System, C. D. Tisdale, Boston, Mass., 518,298. Filed April 26, 1893.

The invention consists of a truck with three or more insulated wheels and one or more auxiliary wheels for taking the current from one of the rails and returning it to the other.

Automatic Trolley Wire Finder, T. Straus, Baltimore, Md., 518,357. Filed Jan. 26, 1894.

Trolley Wheel, J. D. Ansley, Cambridge, Mass., 518,362. Filed July 27, 1893.

Claim 1 follows:—

A bushing of pure copper for trolley wheels and loose pulleys.

Bond for Electric Railways, J. Meyer, New York, 518,414. Filed Jan. 18, 1894.

Employs a container filled with insulating material for insulating the bonds at their points of contact with the rails.

Electric Railway Conduit, P. P. Banholzer, Philadelphia, Pa., 518,540. Filed Nov. 16, 1893.

Claim 1 follows:—

In an underground trolley system, the combination with a conduit having openings in its sides in addition to the slot opening of conductors arranged in the said conduit, a plastic material forced into the conduit through the side openings, and securing the said conductors in place.

Switches and Cut-Outs:—

Electric Switch, A. Ekström, Lynn, Mass., 518,231. Filed Dec. 24, 1890.

The invention consists in certain details of construction to prevent arcing in switches for alternating currents.

Rheostat, J. P. B. Fiske, Lynn, Mass., 518,236. Filed Feb. 25, 1893.

Claim 1 follows:—

A rheostat comprising a frame and a tier of removable trays supported therein, each tray containing a resistance coil.

Rheostat, A. C. Dinkey, Allegheny Co., Pa., 518,365. Filed Dec. 1, 1893.

Electric Starting Switch, F. V. Henshaw, Brooklyn, N. Y., 518,404. Filed June 2, 1893.

Provides a mechanical device for starting the motor and automatically cutting off both main lines by means of a magnet operated by current from the main line acting when energized to hold the switch closed.

Electric Switch, J. B. Smith, Manchester, N. H., 518,471. Filed Oct. 10, 1893.

An automatic switch for protecting the armatures of motors from excessive overload.

Electrical Contact Mechanism, J. F. Blake, New Haven, Conn., 518,481. Filed Feb. 23, 1894.

Telephones and Apparatus:—

Telephone Apparatus, C. Mildé, Paris, France, 518,263. Filed Oct. 31, 1893.

Claim 1 follows:

A microphone consisting of a metallic corrugated box partly filled with granulated and purified coke, said box having a carbon stud or bead extending through it on each side and carrying a weight, one of the beads being connected to the vibrating transmission plate.

Telephone Exchange System, J. I. Sabin and W. Hampton, San Francisco, Cal., 518,331. Filed Jan. 19, 1894.

Employs an individual annunciator and battery at the central station in the bridge of the metallic circuit, a normally open telephone circuit at the subscriber's station, and means for closing the latter and cutting out the annunciator and battery.

Telephone System, J. I. Sabin and W. Hampton, San Francisco, Cal., 518,332. Filed Nov. 14, 1893.

Provides means for automatically signaling for connection and disconnection and for transmitting to the operator a selective signal for connection with a subscriber while already connected with another subscriber.

Telephone Exchange System, J. I. Sabin and W. Hampton, San Francisco, Cal., 518,333. Filed Mch. 3. 1893.

Similar in its object to No. 518,331.

Tetephone Exchange System, J. I. Sabin and W. Hampton, San Francisco, Cal., 518,334. Filed Apl. 13, 1893.

Similar in its object to No. 518,331.

Multiplex Telephony, W. W. Jacques, Newton, Mass., 518,367. Filed Nov. 22, 1893.

Employs a telephone line with two telephones in each end, two vibrating switches one at each end of the circuit and mechanism for vibrating the switches synchronously and rapidly.

Telephone Transmitter from Secondary Batteries, J. J. Carty, New York. 518,392. Filed Apl. 14, 1891.

Claim 1 follows:

The combination with a battery or other source of electricity, having very low internal resistance, of telephone transmitters connected in parallel between the poles of the battery and deriving current therefrom.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

REMOVAL OF THE CHICAGO OFFICE OF THE GENERAL ELECTRIC CO.

THE recent removal of the Chicago offices of the General Electric Company from the old Edison General Offices at 173 Adams street to the Monadnock Building was due to a conclusion reached several months ago that more room was required for the large stock of goods that this company carry, and better facilities for making shipments. The new storehouse is located on the line of the Wisconsin Central, Chicago & Great Western and Baltimore & Ohio Railways, and is splendidly situated for shipping purposes, the Company is therefore in shape to make even prompter shipments than heretofore.

The removal of the stock to this new storehouse left the Adams street building partially vacant, and other quarters for office purposes were sought, arrangements finally being made for a portion of the tenth floor of the Monadnock Building. The rooms occupied, 1042 to 1056 inclusive, take up the whole of the South end and are fitted up handsomely, so that they now have one of the finest suites in the building, which means one of the finest in Chicago.

Entering the offices from the hall the Accounting Dept., Credit Dept., and Cashier are on the right; on the left are the General Manager's office and the telegraph and telephone operators. A railing separates the hall from the main office, on which are located the salesmen, purchasing agent, engineers, etc.; with the Railway Dept. under Mr. T. P. Bailey, Power & Mining Dept. under Mr. W. F. White, Lighting Dept. under Mr. J. W. Johnson, and Supply Dept. under Mr. A. M. Searles.

The offices being so high up are lighter and freer from noise, dirt and smoke than the old offices nearer the street; and from the windows is had a magnificent view of the city. The swift running elevators bring these ten stories within easy reach of the street. The Monadnock Building is becoming known as the electrical centre of Chicago, and now that the General Company is installed there it will no doubt soon be filled with other electrical concerns.

THE BROOKLYN EDISON ILLUMINATING CO.

The stockholders of the Brooklyn Edison Illuminating Co. have voted to increase the capital from $2,500,000 to $3,000,000 in order to take care of new city lighting contracts. The company is now paying quarterly dividends of 1½ per cent.

ANOTHER CONNECTICUT POWER SCHEME.—TERRY'S ISLAND.

TERRY'S ISLAND, in the Connecticut River, opposite Enfield and Suffield, has been sold to an electric syndicate for electric purposes. The sale was made last week and the property has been transferred to H. Douglas, of Windsor Locks, the syndicate's agent. It is proposed to build a dam across the river at this point where an almost unlimited amount of power can be developed for supplying the surrounding towns with electricity.

NEW ENGLAND NOTES.

MR. C. T. SNEDEKOR, for many years associated with the Washburn and Moen Manufacturing Co., of Worcester, Mass., has gone to Europe for a few months on important business.

MR. J. J. GATES, of the Royal Arc Electric Co., of New York, was in Boston this week, in the interests of his company, and reports excellent prospects for a speedy adoption of their system for many lighting companies in all parts of the country.

MR. F. S. DE RONDE, of New York, was in Boston this week, and favored this office with a call, where he convinced the writer that the electrical business was not entirely dead by showing him some large orders which he had just received for many of the well-known P. & B. specialties.

THE DAVIDSON VENTILATING FAN CO., of Boston, have recently been appointed New England agents for the well-known Columbia incandescent lamp, and also for the Stanley motors. With these two standard specialties added to their list, the Davidson Co. are now well prepared to enter the electrical field, and are particularly well favored in having such an excellent location at the corner of Oliver and Milk streets.

G. M. ANGIER & CO., No. 116 Bedford St., Boston, Mass., have accepted the exclusive agency in New England for what they call "The Three Good Things." The Kester arc lamp, which burns equally as well on either the direct or alternating current, the Climax iron clad rheostats and stage dimmers, and the Sechrist automatic switch, which is said to be the only switch of the kind that can be wired and connected by ordinary battery or office wire.

THE PERKINS ELECTRIC SWITCH MFG. CO., of Hartford, Conn., have just got out a handsome catalogue of all their most recent specialties, including the new Gibbs switches, recently illustrated in these columns, and the Waterhouse arc lamp for incandescent and arc circuits, which this company is now manufacturing and selling exclusively in the United States. Mr. F. B. Smith, who represents the company, in the Hathaway Building, Boston, has got a full line of samples in his office, and the arc lamps can be seen in actual service at any time.

MR. FRANK B. PARSONS, who is well-known as the manager of the Davidson Ventilating Fan Co., of Boston, and who has gradually for the past year or two been working into the electrical business, has taken the New England agency for the cables and wires of the Norwich Insulated Wire Co., of East Newark, N. J., and will carry a full line of goods in his office in Boston. It is expected that considerable underground work may be done in Boston within the next few years, and Mr. Parsons is determined to be well equipped with the best material he can find.

THE ELECTRIC STORAGE & POWER CO., is at present being organized in Boston, under the laws of Massachusetts, for the purpose of manufacturing and selling the storage battery of Captain A. De Khotinsky, who owns many valuable patents on accumulators, and who has had as much, if not more, experience in accumulator business for central station work, than any other man in this country. Mr. H. W. Morton, recently with the Bradbury Stone Battery Co., is president, and Mr. A. E. Appleyard, who is deeply interested in central station work in Massachusetts, is treasurer. They have not yet decided upon where their factory will be, but are at present to be found at No. 542 Exchange Building, Boston. They have already installed one small plant, and have inquiries for many more, and owning as they do the sole right to Capt. De Khotinsky's valuable accumulator patents, a good business in this specialty is expected, as soon as they get properly started.

THE CARTWRIGHT ELECTRIC CO., 145 Milk street, Boston, of which Mr. D. J. Cartwright is president and Mr. J. Sheldon Cartwright treasurer, report that they are now prepared to act as consulting electrical engineers or contractors for electric light and power installations. They are manufacturers of several new electrical specialties, and having suitable work rooms for all repairs on dynamos and motors, would be pleased to receive a call from their many friends and acquaintances. Mr. D. J. Cartwright is the inventor of the well-known Cartwright porcelain specialties and lately in charge of the isolated construction of the Edison Electric Illuminating Co. of Boston. Mr. J. Sheldon Cartwright was formerly with the Edison General Electric Co., The General Electric Co., and the Edison Electric Illuminating Co., of Boston, in various capacities. Both of these gentlemen have been identified with electrical interests for many years and the excellent reputation for good work they have enjoyed in the past, will be fully sustained in the future, and is a sufficient guarantee of the results, from anything that may be entrusted to their charge. Their motto will be "A fair price for first-class reliable work and satisfaction to all."

THE STANDARD ELECTRIC COMPANY'S ALTERNATING SYSTEM.

For something over a year the Standard Electric Company, Chicago, have been at work getting out a complete line of arc, as well as incandescent apparatus, both of the direct and alternating current type. In a recent issue of THE ELECTRICAL ENGINEER we described and illustrated one of their multipolar direct current generators, and now are enabled to give a description of their alternating incandescent system, which has lately been perfected by their engineer, Mr. C. E. Woods.

Fig. 1 shows a 65 K. W. alternator with exciter attached. It will be noticed that the field of this machine, as far as the design is concerned, is a new departure in alternating apparatus, being of the consequent pole type, following the lines carried out in the company's arc and direct current generators. This, it is claimed, not only makes the gross weight of the machine much less for its output, but gives it a graceful and symmetrical appearance. The field coils are all wound by hand, insuring perfect workmanship and good insulation. The absence of any long inwardly projecting poles also gives much better ventilation to the field and armature.

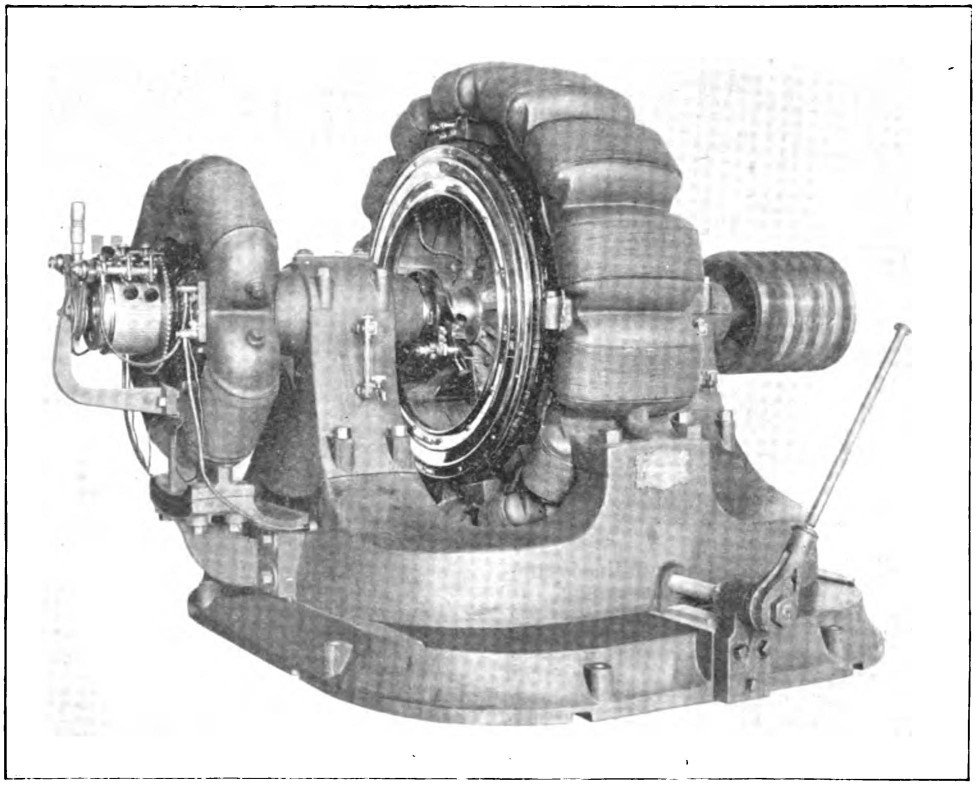


FIG. 1.—THE STANDARD ALTERNATOR WITH EXCITER.

The armature is of the usual drum type, surface wound, the winding being so calculated and arranged as to have a minimum of self induction. This makes the regulation of the machine almost entirely automatic within the limits of the capacity of the machine. The iron core is built up of soft iron rings in the usual manner, the radial depth of the rings being reduced as much as possible, consistent with the proper proportions for a machine working at this frequency, that is, 125 ∼ per sec.

The exciter consists of a small multipolar machine, conforming in general appearance to the alternator itself. The exciter field frame is supported by a brass bracket bolted to the alternator base. The exciter armature is, as stated, mounted directly on the alternator shaft, one end of which is extended for that purpose. This leaves the exciter without any bearings, the entire machine containing simply the two main journals. The trouble of keeping three journals in perfect alignment is thereby avoided and the mechanical construction much simplified. The armature of the exciter being cross-connected, reduces the number of brushes to two, placed 90 degrees apart on the upper side of the commutator. This makes the brushes easy of access for the purposes of inspection, cleaning or adjusting. The complete machine is mounted on a substantial iron sub-base, provided with a right and left-hand ratchet for tightening or slacking the belt. The frame is tapped at both ends so that the ratchet arrangement may be applied to either end as may be most convenient.

The field of the machine being split in the middle, allows the upper half of the field to be raised for removing the armature if necessary; or, since the journal seats are bored to the same radius as the armature base, it may be removed endwise if found more desirable. The journals are self-oiling, ball bearing and have glass oil gauges of an improved form, making it impossible for them to leak. The main collector rings are placed one on each end of the machine, avoiding all danger of contact with both rings at the same time.

These machines are at present built in four sizes of 500, 750, 1,250 and 2,500 light capacity. The two smaller machines have 12 poles and run at a speed of 1,250 r. p. m., the 1,250 lighter has 14 poles and a speed of 1,070 revolutions, while the largest machine with 18 poles runs at only 830 revolutions.

The efficiency of these alternators is said to be the highest attainable in machines of this class; the losses in the armature of a 65 K. W. machine by $C^2 R$, hysteresis and Foucault currents being only 1,905 watts, the $C^2 R$ loss in the fields being 1,176 watts.

In addition to the dynamos the company are making a complete line of necessary indicating instruments usually found in a central station. The voltmeter and ammeter have been developed and perfected by them for use in connection with their system. The mechanism of these instruments is constructed on the repulsion principle, a fixed and a movable armature being acted upon by a common solenoid. The instruments are claimed to be accurate within 1 per cent., which would seem to be as close as can be expected from an instrument designed for general station work. The scale appears to be perfectly uniform throughout its range.

In the voltmeter, Fig. 2, the error due to the heating effect is claimed to be negligible on account of the relatively high resistance of the instrument. While all instruments are calibrated for a frequency of 125 ∼, a simple means of adjustment is provided in case it is desired to adapt them for currents of higher or lower periods. This means of adjustment is also used in case it becomes necessary to take the instrument apart and afterward re-standardize it, when it is merely necessary to adjust the pointer to any known point of the scale by comparison with any standard instrument. All instruments are mounted on white marble bases and enclosed in plate glass cases, leaving the index needle visible its entire length, thereby making it discernible at a considerable distance.

In the "Standard" ground detector, a new idea seems to have been very successfully carried out, the instrument filling its place under similar conditions as the voltmeter and ammeter. In other words, it is a ground indicator showing not only the existence of a ground or escape, but also its value on a scale. It is a zero instrument and consists essentially of two high resistance coils, one independent of the other as far as electrical connection is concerned. A scale beam, pivoted at its centre, carries a plunger or core at each end, each core being suspended in its coil. At the centre of the beam a pointer is attached, standing normally at zero in the centre of the scale. Each side of the main line is connected through one of the coils to a common artificial ground. If the line is clear, the current divides equally between the two coils, keeping the needle at zero; the slightest escape or ground, however, causes the needle to be deflected toward the side opposite the coil through which the greater portion of the current flows. From the amount of deflection in degrees of the scale an approximate value of the condition of the ground, or its resistance, can be ascertained. The instrument can be left in circuit continuously if desired. For more than one circuit a transfer switch is provided.

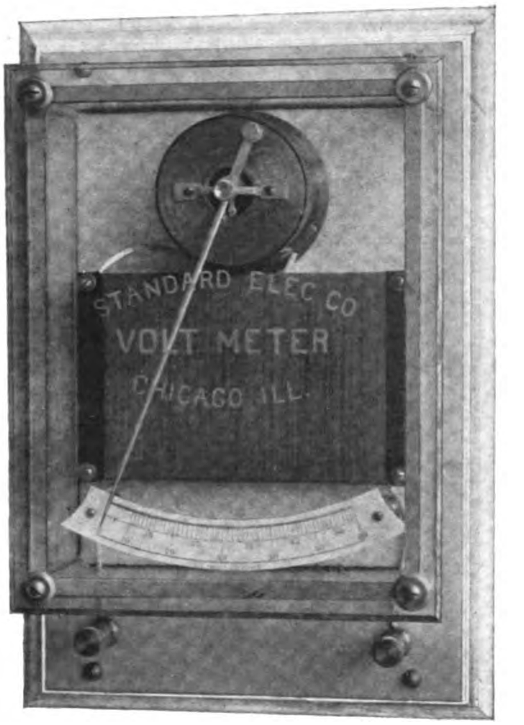


FIG. 2.—THE STANDARD VOLTMETER.

In the "Standard" transformers the company have given special attention to making them practically fireproof inside and proof against moisture from the outside. The efficiency in all sizes above 20 light capacity is claimed to be 96 per cent., and in the largest sizes still higher. The regulation in all cases is said to be within 3 per cent. and in the larger sizes as good as 2 per cent. The iron losses are claimed to be exceedingly small, the core being built up of specially rolled and annealed sheet steel of No. 30 gauge. The magnetic leakage is said to be also exceedingly small. In insulating the coils a specially prepared liquid is used, in which the coils are immersed after having been baked, and while still warm.

Taking all of the above described machinery and appliances, including circuit changing switches of special form, a novel kind of main line fuses, as well as other necessary appliances, it would seem as if the Standard Company had produced a very complete system for alternating current work.

THE CITY BANK, of Buffalo, N. Y., has issued a table of holiday dates, originated by its president, Mr. Cornwell, incident to the operation of the Saturday half-holiday law in this state some years ago, which has been issued each year since, under his copyright. The simplicity and clearness of the table, requiring no explanations or elaborate keys, have made it extremely popular since its first issue, and it has this year been enlarged to cover eighteen months, and contains also a calendar of 1894–5.

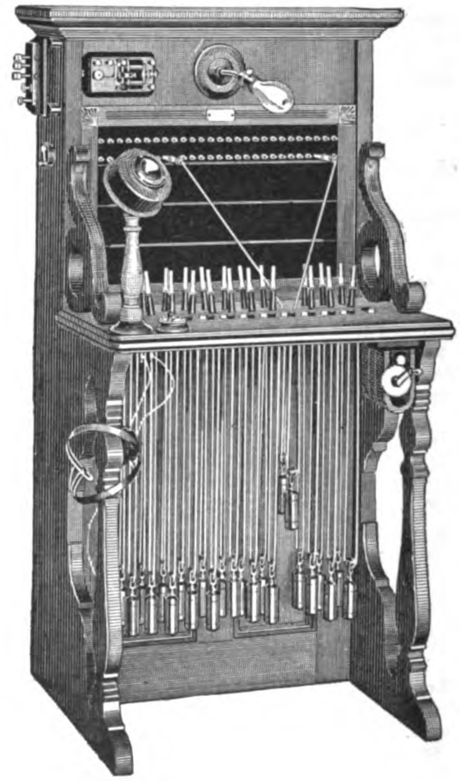
THE ELSON & BREWSTER ENGINEERING CO.

The Elson & Brewster Engineering Co., of 143 Liberty street, New York city, have been very busy of late, and have sent us a list of the contracts in hand during the last few weeks. Among the more important may be mentioned, replacing the telegraph apparatus on the steamship *Portia* and doing considerable wiring on board her sister ship, *Miranda*; installing the ventilating apparatus at the new House of Refuge at Randall's Island; installing for M. B. Baer, 42 and 44 Bond street, a 100 h. p. Ball & Wood high speed engine, a vertical shaft and a 400 light isolated C. & C. electric plant. The switches used in this work are made by the W. S. Hill Electric Co., for whom the Elson & Brewster Engineering Co. are the New York agents. All the electric bells and speaking tubes now being placed in Kuhn, Loeb & Co.'s building, 27 and 29 Pine street are also furnished by this company, as well as a Hill switchboard for the residence of Mr. Aldrich, 61st street and 5th avenue.

The company have lately become the eastern agents for the Akron Electrical Mfg. Co., of Akron, Ohio, and have used one of their motors in a model compressed air plant which they have built to show the workings of the Kinsman block system. They are also making a specialty of moldings in various kinds of wood and in a variety of styles.

THE NATIONAL TELEPHONE SWITCHBOARD.

The accompanying illustration shows the new switchboard of the National Telephone Mfg. Co., of Boston, designed and introduced by them for central station use in towns and in large factories or other buildings where there are sufficient stations to make the employment of a switchboard and attendant economical. There are, as will be noticed, no drops to show who is calling. The caller simply rings for "Central," asks for the number he wishes and then does his own ringing up. If, in doing so, his own bell does not ring it means that the line is busy.



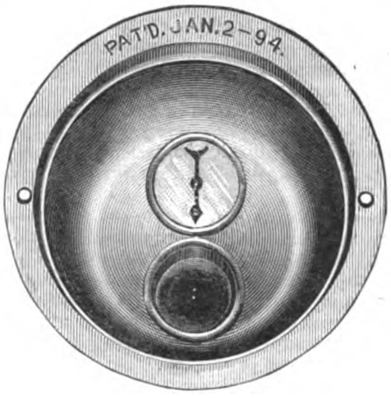
THE NATIONAL TELEPHONE SWITCHBOARD.

The board is of the company's latest design and contains all of their latest improvements up to date. An illustrated description of the National Telephone Mfg. Co.'s system will be found in THE ELECTRICAL ENGINEER of February 21, 1894.

GREEN ISLAND, N. Y.—The laundry, kitchen, engine and boiler rooms for the Green Island Improvement Company's new hotel at Lake George, N. Y., will be built of iron, fireproof. Warren & Bacon are the architects. The work is to be furnished by The Berlin Iron Bridge Co., of East Berlin, Conn.

THE HUNKING PUSH BUTTON.

A great novelty in its line is the indicating push button shown in the accompanying illustration and recently patented by Dr. C. D. Hunking of this city, in which a magnetic needle indicates by its movements the condition of the circuit. It is, in fact, a rheoscope and push button combined and is designed for use wherever a simple push button is needed.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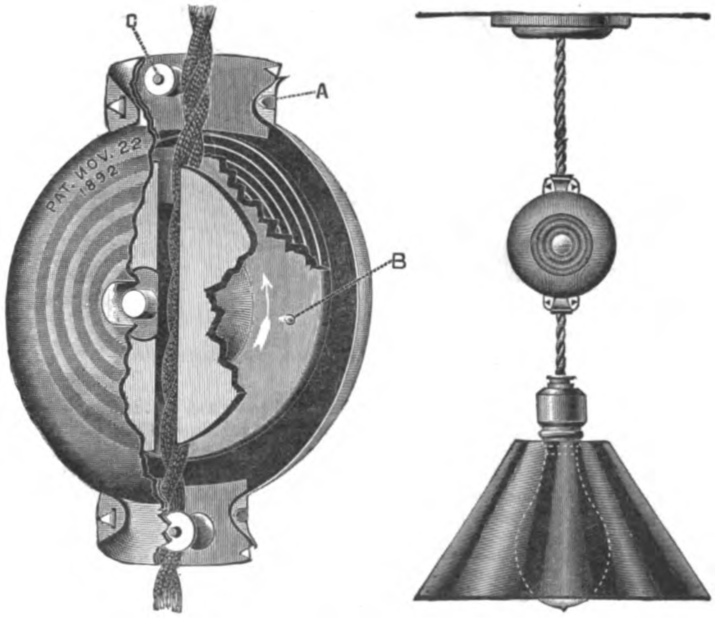
The Hunking Push Button.

The magnetic needle with which it is supplied gives visual notice when the current passes so that the operator of the push button can see at a glance whether or not the circuit is in the proper condition. If the circuit is incomplete, the needle will remain stationary. If a constant current be passing, the needle will take a horizontal position and keep it until the current is broken. An interrupted current, as when an electric bell is in the circuit, will be indicated by a vibratory movement of the needle while the intensity of the current will be denoted by the rapidity with which the needle is actuated. The needle will deviate to the right or to the left according to the direction of the current.

The advantages of this button will readily be seen, especially when its cost is hardly more than the ordinary push button. It is being introduced by Messrs. Stanley and Patterson, 84 Frankfort street, New York city, in burnished bronze and can be made in all the ordinary materials, shapes and sizes. Such an indicating device is often needed and should prove valuable.

THE PORTER LAMP ADJUSTER.

The accompanying illustrations, Figs. 1 and 2, show the Porter adjuster for incandescent lamps, a valuable and simple device by means of which the lamp may be placed at any height in a moment without in any way interfering with the length of the cord or leaving it hanging in unsightly loops or coils. Fig. 1 shows the action. Half of the polished copper case is removed and the lamp cord is pressed into the slot. The cover is then replaced and held in position by the four points A. The spindle tends to turn in the direction of the arrow and is held in place until the lamp is in position by the pin B. The weight of the lamp then balances the tension of the spring, and the adjuster is ready for action.

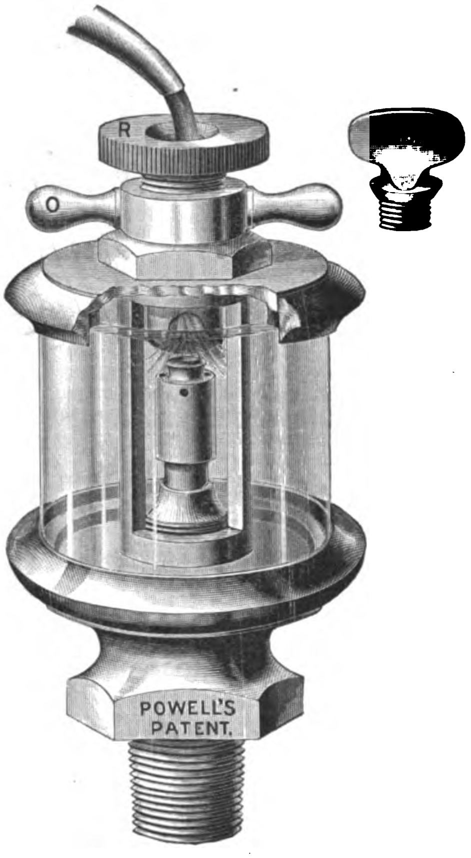


Figs. 1 and 2.—The Porter Lamp Adjuster.

Fig. 2 shows the device in operation. It is being introduced by George L. Colgate, 136 Liberty street, this city.

POWELL'S AUTOMATIC CRANK OR WRIST PIN OILER.

The new style of crank pin oiler shown in the accompanying illustration, is an improvement on the old one, formerly manufactured by the Wm. Powell Co. of 225–231 Spring Grove avenue, Cincinnati, Ohio. The central adjusting screw R has been enlarged sufficiently to afford diameter enough to form a passage for the oil when refilling. During the process the filling cap or plug B is removed, the cup being filled from the oil can as shown. After filling, the plug B is replaced, and the lift of the valve to deliver the proper quantity of oil is adjusted by means of the central adjusting screw R which is then secured in place by the lock nut O. The cup can be refilled at any time without altering the adjustment, which will be found a great convenience as compared with the older form. These oilers are made in sizes ranging from 1¼ to 3⅛ inches diameter, of glass, from 1⅛ to 4 inches in height, and of capacities from ⅛ ounce to one pint.



Powell's Automatic Oiler.

THE DEMAND FOR MATHER APPARATUS.

Among the hopeful signs of revival of trade is the encouraging statement made by Mr. Thomas C. Perkins, of the Mather Electric Co., that the last month's business of that company footed up equal to that of any in the previous history of the company. This speaks well both for the quality of the Mather apparatus as well as the activity of its business management.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY.

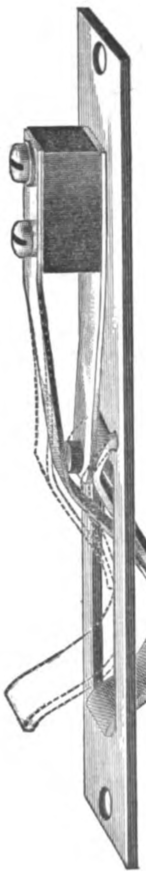
The Manhattan General Construction Company, of 50 Broadway, New York and 753 Monadnock Building, Chicago, has made arrangements with Mr. W. H. Fleming to act as selling agents for his patent woven wire gauze dynamo brush. All orders and inquiries relating to prices and sizes of brushes in stock ready for immediate delivery should therefore be adressed to them.

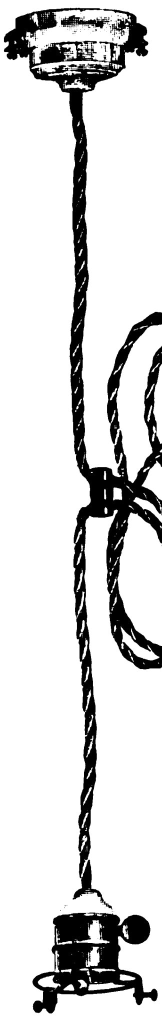
THE GEARY & MOSSOP WINDOW SPRING.

The window spring shown in the accompanying illustration is the latest production of Messrs. Geary & Mossop, and is now being manufactured by them in the factory of the Arnold Electric Co., at Chester, of which Mr. Craig R. Arnold is the selling agent, with offices at Chester and 808 Walnut St., Philadelphia.

The great trouble heretofore experienced in the manufacture of such a simple device as an electric window spring, has been due to rust and corrosion of the contact parts. Brass screws are used and the springs are made out of a high grade of German silver, thereby overcoming the danger of rust and corrosion. It will be seen that the tongue is made to hinge on the frame by two little extensions or lugs engaging two holes in the frame. This construction admits of the tongue being removed and a new one substituted without the use of any tools or the removal of any pins or screws.

The device is well made and has the great advantage of being interchangeable.


The Geary & Mossop Window Spring.


The Newton Cord Pendant.

THE NEWTON CORD PENDANT.

The accompanying illustration shows a complete cord pendant which is being manufactured and introduced by the Newton Electric Company, of 39 Cortlandt street, New York. It consists of a kilowatt rosette, six feet of flexible cord with an adjuster, a cord socket for the Edison system and a shade holder with rosette and connections. The device will be found a great convenience over the method, often employed, of making all the connections where the work is being installed.

Besides this standard pendant the manufacturers supply special lengths at short notice.

The Penn General Electric Co., have been awarded the contract for the plant and wiring for the new building of Allen, Lane & Scott.

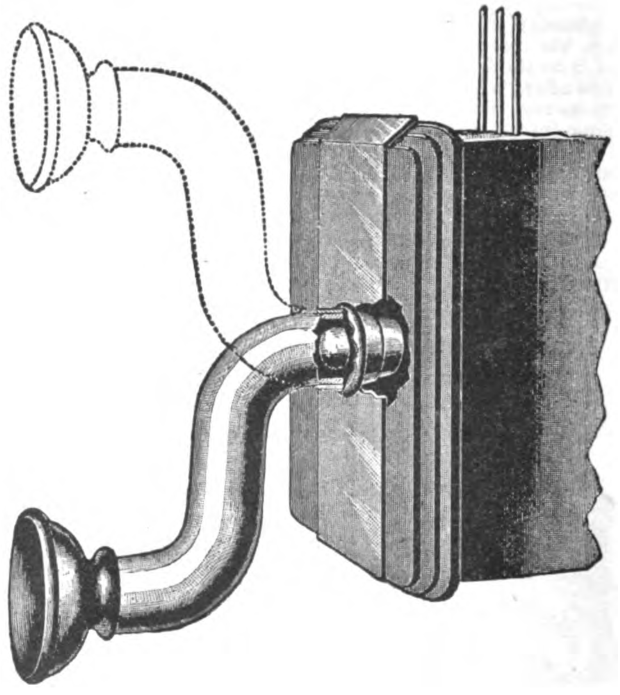
CENTRAL ELECTRIC COMPANY.

The large and commodious quarters which the Central Electric Company will occupy about May 1st, at 173 and 175 Adams street, after having undergone a complete and thorough rearrangement and refitting are rapidly nearing completion. The offices, as at present, will be located on the ground floor, and will be convenient and accessible. The office trimmings, counters, shelving and in fact all the fittings of the establishment will be of antique oak, giving a rich and substantial appearance. The building will be complete in its electrical equipment, and the different types and sizes of the Lundell power motors, exhaust and ventilating fans, will be exhibited in actual operation. The complete Interior Conduit system of wiring will be carried throughout, brass armored conduit being used, with the new iron armored conduit for risers, the details of which will be given more fully later.

The Kinsman desk light for which the company are general selling agents, is meeting with a ready sale, and its advantages are so apparent that it becomes popular at sight. The large factory which the company owns and operates at Columbia City, Ind., for the exclusive manufacture of pins and brackets, has been running to its full capacity, the heavy construction orders which the company have recently received having made it necessary to do so in order to fill orders promptly.

THE COOK EXTENSION TELEPHONE TRANSMITTER.

The accompanying illustration shows an attachment for telephones devised by Mr. V. A. Cook, Averill Park, N. Y. It is claimed to increase the efficiency of a telephone 50 per cent. by concentrating the sound waves and leading them by an indirect route to the diaphragm. An oval plate in the tube further serves as a protection to the instrument in case of too loud talking. The tube is made of brass and may be turned in any direction to accommodate people of different heights. It is attached by placing the large flange over the top of the transmitter box door, having the opening in the plate in line with the diaphragm, and springing the shorter flange over to the lower edge of the door.


The Cook Extension Telephone Transmitter.

HOLTZER-CABOT ELECTRIC COMPANY.

This company has just opened a branch office in New York City, under the management of Mr. David Chalmers, who has, until recently, been the assistant receiver of the house of Alexander, Barney & Chapin. The New York office and salesroom are located at 114 Liberty street, where the Holtzer-Cabot Electric Co. will carry a full line of their well-known specialties. Both this company and Mr. Chalmers are to be congratulated upon the new venture.

GENERAL ELECTRIC CO.'S THREE-PHASE APPARATUS.

THE apparatus employed by the General Electric Company in its three-phase power transmission work has all been designed with a view to obtaining high commercial efficiency and close regulation. The illustration, Fig. 1, shows a 300 K. W. three-phase generator and Fig. 2 a 15 h. p. three-phase induction motor. In the generator the armature and field coils are all highly insulated so that the danger of accidents is reduced to a minimum, and fairly high voltages may be used with the certainty of obtaining a thoroughly reliable machine. The bearings are self aligning and self oiling, and the armature, being carefully balanced upon rigid supports, the machines run with scarcely a tremor. The magnetic circuit and the windings are so proportioned that the machine runs exceptionally cool and requires little or no attention to the rheostat even under considerable changes of load.

In the large direct driven machines, and in all cases in which light weight is essential, the magnetic circuit, aside from the armature, is composed of cast steel. The standard periodicity employed is 60 cycles per second or 7,200 alternations per minute. This is sufficiently high to permit the ready use of incandescent and arc lamps and the employment of all standard transformers. It is also low enough to permit the use of induction motors under the most advantageous conditions and to avoid trouble from self induction and capacity effects on the line except at very great distances.

Certain of these machines are arranged to run at 33 cycles, which periodicity is that adopted for very long work in order to reduce the induction and capacity effect on the line, and in plants where the use of rotary three-phase continuous current converters is of prime importance. All of these three-phase generators can be arranged for direct driving from Pelton wheels and the larger units lend themselves with facility to direct coupling to turbines. They have an efficiency of at least 90 per cent., rising to 95 per cent. in the largest sizes. With slight changes they can be used as self starting synchronous motors. They come up to speed under light loads without the intervention of clutches or starting motors. They are fully as efficient as the generators, and run in absolute synchronism with them, even under heavy overload. Synchronous motors are of especial value in power transmission as by strengthening their fields it is possible to compensate for loss of voltage due to induction in the line.

The three-phase induction motors are substantially equal to good shunt wound motors, but have no moving contacts, the only connection with the outside circuit being through the three binding posts on the top of the motor. The magnetic part of the field and armature is constructed of annealed laminated iron. The current from the outside circuit passes through windings imbedded in the stationary field punching. The winding of the armature has no connection with the electric circuit but is short circuited on itself through a small number of heavy copper bars united at the ends by connectors. It is furnished with a starting resistance placed within the armature spider. At starting, a sliding collar along the shaft is kept out of contact with the switch serving to short circuit the resistance. When the motor is nearly at speed the contact ring is slid along the shaft, engages the switchpoints and short circuits the armature. This renders possible a large starting effort with a current limited by the resistance, which is so adjusted as to give a starting torque equal to the running torque at full load with somewhat less than the full load running current.

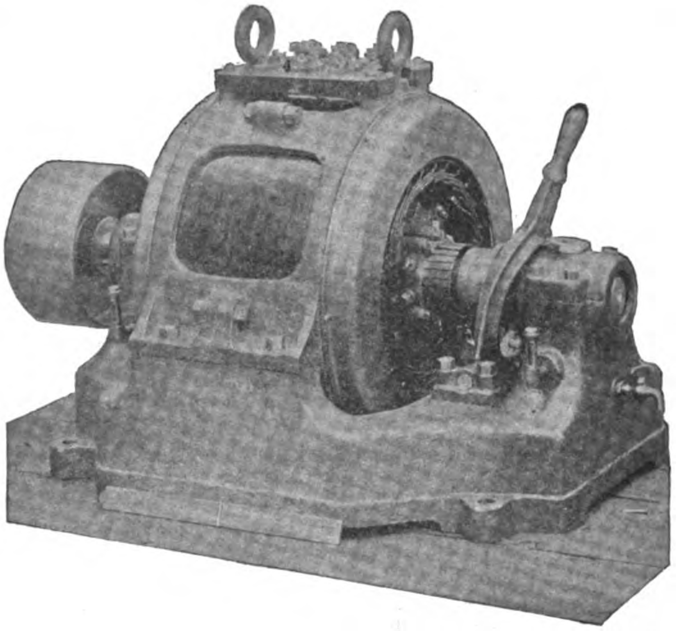


FIG. 2.—GENERAL ELECTRIC 15 H. P. THREE-PHASE INDUCTION MOTOR.

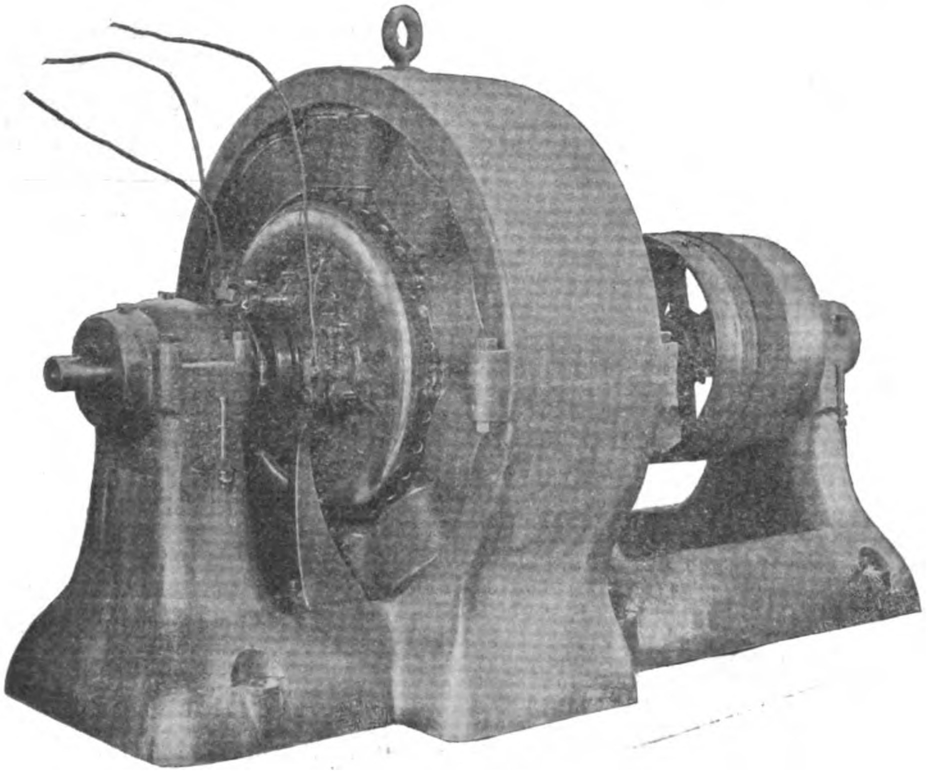


FIG. 1.—GENERAL ELECTRIC 300 K. W. THREE-PHASE GENERATOR.

The massive character of the armature winding in which the E. M. F. is only from 10 to 25 volts renders burnouts almost impossible, and the absence of commutators and collecting rings obviates the danger of sparking. It is claimed that these induction motors are electrically equal to direct current machines of the same capacity. They are recommended for all units below 100 H. P., above which synchronous motors would be preferable.

SALE OF DETROIT STREET RAILWAY PROPERTIES.

Thomas Nevins & Sons, the contractors, of Orange, N. J., have bought for a syndicate of capitalists the entire plant and rolling stock of the Detroit Street Railway Company, which includes some forty miles of equipped electric road in Detroit, Mich., and some forty more miles of valuable franchises. The price paid is said to have been $8,000,000, half of which was paid in bonds and the remainder in stock in a new company, which is to be formed with an increased capital stock of $10,000,000, and which will avail itself of all the franchises already obtained, and make extensions in various directions.

WESTERN NOTES.

The Standard Electric Co., Chicago, will soon issue a new catalogue, containing complete descriptions of their Light and Power apparatus.

The Taylor-Belding Electric Co., at Chicago has been incorporated by Chas. H. Taylor, W. S. Belding and David Fales, with a capital stock of $10,000.

Thos. G. & Edw. R. Grier, Western Representatives of the Bryant Electric Co. will move their office to 1,532 Monadnock Block, Chicago, on May 1st next.

Mr. E. P. Roberts, Pres. of the Correspondence School of Technology, Cleveland, was in Chicago last week. Mr. Roberts reports the success of his enterprise as very encouraging so far.

Bartholomew, Stow & Co., Chicago, will move on May 1st, to No. 19 N. Clinton St., where they will have a large shop and better facilities in general to take care of their growing business.

Champaign, Ill.—The Urbana and Champaign Street Railway Co. and the Champaign Rapid Transit Co. have been consolidated under the name of the Urbana and Champaign Electric Street Railway Co., with a combined capital stock of $50,000.

Mr. Harry G. Osburn, 239 La Salle St., Chicago, having resigned the agency of the La Roche Electric Works, has associated himself with his brother Mr. M. Roy Osburn in the electrical engineering and supply business, the style of the firm being Osburn Bros.

The Knapp Electrical Works, Chicago, are preparing a new edition of their general catalogue. In addition to the already very complete line of electrical apparatus and supplies, they will hereafter manufacture and carry in stock a complete line of electric railway material and supplies.

Finney & Modisette, New York Life Building, Minneapolis, Minn., have opened offices recently for the transaction of a general electrical contracting business, and have taken the agency for the Fort Wayne Electric Co. They hope to secure a good trade in generators, motors, transformers, instruments, switchboards, etc.

The Central Electric Co., Chicago, are busy getting settled in their new quarters on Adams St. Ordinarily the moving of a concern like the above without more or less interruption to their business, would seem almost an impossibility, but so well were the arrangements planned and executed that nearly all shipments were made with the usual promptness.

The Chicago Telephone Co., owners of the McClellan patent on a district alarm box, has brought suit in the United States Court against the Chicago Electric Protective Company for the alleged infringement of said patent, claiming that the alarm boxes used by the defendant are an imitation and infringement. An injunction and damages are asked for.

Adrian, Mich., is without street car service at present, unless the Street Railway Company resort to the antiquated system of mule power. The Electric Light Co. is said to have an unpaid claim against the railway for furnishing power and refused to let its generators generate or the motors "mote" until the claim is paid. The railway company is said to also owe its employés and has a bonded debt of $36,000. There is talk of a receiver being appointed.

Against Trolley Wires. The Chicago council committee at its meeting on the 18th inst., by a vote of 6 to 5 decided to amend the Chicago City Railway Company's trolley ordinances, so far as to require the trolley wires to be placed underground. A letter from General Manager Wheeler, of the Love Electric Traction Co. was read to the committee. In his letter Mr. Wheeler, among other things, claimed that the Chicago Street Railway officials ignore the underground trolley system because they have not investigated it. He claims it can be built as cheaply as an overhead system and that the cost of maintainance is 33⅓ per cent. cheaper. He wants a chance to appear personally before the committee, or have the committee come to Washington to investigate. He evidently doesn't bank much on the Love road in Chicago. The ordinance will be again considered in committee meeting on the 23d inst.

PHILADELPHIA NOTES.

The Keystone Electrical Instrument Co. are doing a good business with their voltmeters and ammeters for switchboard work. They have just manufactured a large number of these instruments highly finished in brass for the LaRoche Electric Works.

Mr. F. A. LaRoche, president and general manager of the La Roche Electric Works, was in Chicago last week closing up some large deals for their celebrated generators for which they are receiving a large number of orders through their western agents Messrs. Hood & Osburn.

Harry S. Smith & Co., Ltd., have in press an attractive illustrated catalogue of fans and fan motors for all purposes. They will sell this season the Ries & Scott fan motors for alternating current and the Crocker-Wheeler fan motors for direct current; and Huyett & Smith's direct coupled exhaust fans for kitchens, restaurants and factories.

Dr. Drysdale, the consulting engineer, of Philadelphia, has placed the contract for an iron roof over the new power house for the Hospital for the Insane, at Norristown, Pa., with the Berlin Iron Bridge Co. It was desired that the roof be fireproof, and ordinary corrugated iron could not be used on account of the drip, so that the roof will be covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron covering.

Queen & Co., Philadelphia, when they produced their well-known T. 305 testing set, made a very important advance in the matter of portable testing instruments. Still, their electricians were not satisfied to let this remain, and devoted themselves to further study of the problem. The researches of Ayrton and Sumpner on the D'Arsonval, supplemented by extended experiments in the Queen laboratories, have resulted in a galvanometer of increased sensibility, as well as portability. The use of platinoid wire having very high specific resistance and the careful proportioning of coils enabled them to very much diminish the size and weight necessary for the bridge, so that the whole testing set is now contained in a box 8" x 6" x 5". When it is considered that this set comprises a Wheatstone bridge having a theoretical range from .001 to 10,000,000 ohms, a silver chloride testing battery, D'Arsonval galvanometer and necessary double contact keys, one appreciates the great advance made possible by careful study and experiment. Those interested may obtain full information by sending for circular No 521.

NEW YORK NOTES.

Westinghouse, Church, Kerr & Co. call the attention of their friends to their new addresses, 26 Cortlandt street, New York, and 171 La Salle street, Chicago.

The Mica Insulator Company, 218 Water street, have put in a telephone, No. 968 Cortlandt. Their numerous customers can now be in constant communication with them should they be in need of Micanite.

SOUTHERN NOTES.

The Arkansas Electric Supply Co., of Little Rock, Ark., W. G. Brown, manager, has been awarded the contract for the electric light plant to go in the Arkansas Deaf Mute Institute.

St. John, N. B.—Mr. E. C. Jones, the local manager of the bank of Montreal has bought at auction, for $92,000, the electric railway and lighting plant of the Consolidated Electric Co. of St. John, of which Mr. John F. Zebley was the promoter. It is said that Mr. Jones will overhaul the plant and put it in good earning condition.

The Wagner Elec. Mfg. Co. of St. Louis, have appointed the following agents to represent their manufactured lines of transformers, fan motors, power motors, generators and switches: Eastern agent, John Mustard, Betz Building, Philadelphia; Northwestern and Canadian agent, Wells Goodhue, 1,564 Monadnock Block, Chicago; Southwestern agents, Western Electrical Supply Co., St. Louis.

The Allgemeine Elektricitaets-Gesellschaft, Berlin, Germany, announce that, owing to the general appreciation which their exhibition has met at the World's Fair, it is their intention to appoint selling agents in New York, Chicago, Cincinnati, Atlanta, San Francisco, Boston, Philadelphia, St. Paul, Washington, Denver, etc., for the sale of their manufactures. Trustworthy electrical firms, inclined to handle their goods are requested to forward offers to head offices, 22 Schiffbauerdamm, N. W., Berlin.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. MAY 2, 1894. No. 313.

AN ESTIMATE OF THE DISTANCE TO WHICH NIAGARA WATER POWER CAN BE ECONOMICALLY TRANSMITTED BY ELECTRICITY.

BY EDWIN J. HOUSTON, PH.D. AND A. E. KENNELLY, F.R.A.S.

ONE of the most important questions of the day is, How far is it commercially possible to transmit water power electrically? It is recognized that the limiting commercial distance depends upon two associated interdependent factors; viz., cost and electric pressure.

(1.) *Cost*, including the purchase and maintenance of the necessary machinery and wires together with the annual interest chargeable upon such expenditure.

(2.) *Electric Pressure*. The pressure or voltage at which the line transmitting the power can be operated with continued security to life, and assurance of permanence of supply, and permanent protection to the lines of conductor from lightning, weather and all disturbances.

It is clear that if reliable machinery could be purchased cheaply enough, and the conductors could be safely operated at sufficiently high pressure, the Falls of Niagara could to-day stop steam engines in New Orleans, La., by underselling their power.

Up to the present time the commercial distance at which water power has been distributed is only about 25 miles and the distance to which it might be distributed commercially under ordinary conditions has been generally regarded as a radius of fifty miles.

In one sense the celebrated exhibition in 1891 of the transmission of about 200 H. P. from Lauffen to Frankfort, acted as an incentive to long distance electrical transmission, since it revealed the capability and feasibility of the system, but at the same time, this notable experiment has, perhaps, also retarded the progress of the art it was designed to foster; for the cost of installing the entire plant of turbines, generators, aerial conductors, and transformers, is said to have been $84,600. The apparatus was designed for 300 H. P. (223 K. W.) and this would represent an installation cost of $378 per K. W. ($282 per H. P.) delivered in Frankfort. It appears, however, that not more than 200 H. P. was ever continuously delivered, making the cost $423 per H. P. ($567 per K. W.) The annual cost of producing this power in Frankfort with a steady load of 150 K. W. day and night at motor shafts, could hardly be less than $100 per K. W. ($74.60 per H. P.) delivered,—commercially, a prohibitory rate. The distance from Frankfort to Lauffen is 109 miles, the voltage between tri-phase conductors 13,000 to 30,000, and the frequency 40 ~.

Seeing that the Lauffen-Frankfort electrical transmission experiment, the only one over 25 miles in distance yet attempted, although it was a great success from an engineering standpoint, would be a failure commercially, it becomes important to ascertain how far in the near future, power can be electrically transmitted from Niagara Falls at commercial rates. There must be a certain radius from Niagara, within which electrical power will carry death and displacement to the ordinary steam engine, and it is desirable to ascertain how far this radius may be likely to extend.

We shall first assume that a steady transmission of power is to be provided for, from Niagara Falls to various cities along the banks of the Erie Canal as shown in the accompanying table.

The system of transmission must first be decided upon before the details of cost can be approached. It is quite possible that at some future time continuous current generators and motors can be worked up to a total pressure of 50,000 volts. At the present date, however, such pressure cannot be guaranteed with continuous current machines. With alternating current apparatus, we have to choose between uni-phase, di-phase with common return, and tri-phase systems. It can be shown that where the voltage on the line is so high that a certain value, say 50,000 volts at the receiving end, has to be assigned as a safe limit to the maximum pressure between any two conductors, the tri-phase system is the most economical of the three. We shall, therefore, assume this pressure limit and tri-phase at a frequency of 40 ~.

This maximum pressure of 50,000 volts, represents for sinusoidal waves an E. M. F. of 35,350 volts between wires, or an equivalent pressure of 20,410 volts effective from each wire to the neutral point. This is a pressure but slightly in excess of that successfully used in part of the Lauffen-Frankfort experiments (30,000 volts between conductors), and may, therefore, be reasonably assumed as practicable.

The nature and disposition of the conductors is a most important consideration from an engineering standpoint. Three methods have been advocated at different times.

(1.) *The conduit method*, in which insulated cables are buried in underground pipes containing air or filled with oil.

Distance	Miles.	K. W.	H. P.
To Buffalo..................	15*	22,500	30,160
To Syracuse..................	164	7,500	10,060
To Schenectady..............	300	7,500	10,060
To Albany..................	330	15,000	20,110
To various points along canal, for barge propulsion.....		15,000	20,110
		67,500	90,500

* To outskirts of Buffalo city.

(2.) *The subway method*, in which wires are carried on brackets in an underground passage, such as that which connected Machinery Hall with the Manufactures and other buildings in the Chicago World's Fair, room being left for an inspector to patrol the passage way.

(3.) *The ordinary aerial line method.*

Within city limits, there can be no question that either the first or second method is necessary to ensure perfect safety from accidental contacts with high pressure conductors. But in the open air, for example, along the banks of the Erie Canal, the overhead line is by far the cheapest method. Moreover it is not only safe, but is also readily inspected or repaired. Also for distributing power on such a scale as that here considered, a pole line construction can be adopted that would be strong enough to resist time, and defy storms either of lightning or sleet. Overhead lines were employed between Lauffen and Frankfort, and are employed in all the long distance electric transmission systems yet constructed.

We shall now assume that the engineering difficulties can all be overcome by bare, overhead, tri-phase wires, at 35,350 volts receiving pressure, with step-up and step-down transformers at each end of the lines. It remains now to consider only the question of cost.

TURBINES AND HYDRAULIC WORKS.

We require to estimate the annual cost of producing one kilowatt steadily at the turbine shafts at Niagara Falls. It has been stated that the estimated cost of the hydraulic works at Niagara for a total of 119,000 H. P.,

Was..................	$10.50 per H. P.	or	$14.070	per K. W.[1]
If we add as much as 20 per cent. for any possible miscalculation..	2.10	"	" 2.814	"
And also add cost of turbines at..........	5.00	"	" 6.703	"
	$17.60		$23.587	

Allowing 5 per cent. for interest on capital, 2½ per cent. for superintendence and repairs, and 2½ per cent. for depreciation, the total annual cost is 10 per cent. on investment, or $1.76 per H. P., or $2.359 per kilowatt, assuming that the turbines are always running at full load. This, however, is more than can reasonably be expected. The average load under favorable conditions can hardly exceed 60 per cent. of the maximum load handled, making the annual cost $2.932 per H. P. or $3.931 per kilowatt of average annual delivery.

Another line of reasoning is as follows:—It has been stated by Prof. Forbes[2] that he did not continue to add cost to his generators, when $60 of extra expenditure in them did not increase their electrical output by 1 H. P. Prof. Forbes also mentions[3] that he took 5 per cent. as interest on investments, so that it seems clear that his estimate of the annual cost of producing one horse power at generator terminals is 5 per cent. of $60, *i. e.*, $3 per H. P. or $4.021 per K. W.; and eliminating the cost of generators, this would be about $3.72 per K. W. at turbine shafts. However, as our purpose is to be conservative, it may be safer, in the absence of actual assurance, to take $4.00 per K. W. as the cost of power at turbine shafts per annum ($2.984 per H. P.).

GENERATORS.

The cost of alternators, as is well known, varies greatly with their size and capacity. In sizes below 3 K. W. their purchasing cost may be $100 per K. W., while in sizes of say 50 K. W. they may cost $45 per K. W. Finally in very large sizes, say of 4,000 K. W., their purchasing cost would probably be reduced to $8.516 per K. W. ($6.352 per H. P.), including exciters, and all station apparatus.

MOTORS.

The cost of motors may be expected to average slightly higher than that of generators, for the reason that they will frequently require to be made in smaller sizes (say for 1,000 K. W.) than the generators. The purchasing cost per kilowatt may be taken as $9.581 per K. W. ($7.146 per H P.) with exciters and apparatus included.

TRANSFORMERS.

The step-up and step-down transformers would probably not cost more than $5.157 per K. W. ($3.847 per H. P.) Prof. Forbes has stated that offers as low as $3.52 per H. P. ($4.72 per K. W.) have been made to deliver such transformers.[4] These transformers may be conveniently regarded as forming part of the generators or motors at each end of the lines. In this regard, allowing 0.96 as the efficiency of generators or motors, the purchasing cost of generators and all accessories becomes $13.888 per K. W., or $10.352 per H. P. Purchasing cost of motors $14.953 per K. W. or $11.154 per H. P.

The efficiency of complete generator and motor plants becomes 0.94 at full load, allowing 0.98 as efficiency of transformers.

CONDUCTORS.

It is obvious that the right amount of capital to expend in line conductors and construction, after the voltage and frequency have been decided upon, is such that additional expenditure just ceases to save its value in interest, by reason of the consequent reduced loss of power in the line. In cases where the expenditure in the line and construction is in proportion to the weight of copper in the line, this economical point must be attained when the annual charges of interest, repairs and depreciation on the whole line, are equal to the money value of the power lost in transmission along the line, which is Kelvin's law, and is applicable to alternating as well as to continuous currents and whether such currents have lag or not. Usually, however, the expenditure upon the line does not increase directly with the weight of conductor, and the first statement is, therefore, more generally applicable than Kelvin's law. It can be shown that with the prices above mentioned, the most economical weight of copper to employ on each main triphase conductor, will be about 20½ pounds per ampere per mile.

Allowing for the best quality of oil insulators, and bare wires, not exceeding No. 000 A. W. G., a first-class ordinary pole line can be erected for $1,000 per mile of line; and if this allowance be made for the line to each city, the combination will admit of a substantial and permanent structure in wood or in iron, capable of holding all the wires safely, and in a manner practically safe from lightning, yet readily accessible to linemen for repairs. By properly grading the distances between conductors, the antagonistic effects in the lines of capacity and inductance can usually be rendered negligible, so that the fall of pressure in the lines becomes that simply due to ohmic resistance. By systematically transposing the wires of all circuits, say at every mile, their mutual inductance would be negligibly small and their capability of disturbing one another would be consequently annulled.

SUPERINTENDENCE AND OPERATING EXPENSES.

The following staff might be expected to handle the system:

One general superintendent and assistants..................................	$30,000	per annum.
One chief engineer....................	20,000	"
Twelve assistant engineers............	36,000	"
Forty dynamo assistants..............	40,000	"
Forty linemen and assistants..........	40,000	"
	$166,000	"
Office expenses, salaries, taxes, etc..	34,000	"
Total..................	$200,000	"

Or $2.00 per H. P. of total capacity or $2.681 per K. W.

ALBANY.

Distance, 330 *miles; Maximum delivery*, 15,000 K. W.

For a delivery with full load at motor shafts of..........................	1.000	K. W.
The delivery at line terminals..........	1.064	"
And with a power factor of 0.9, the received current on each conductor is.	0.01931	amp.
Copper per mile on each conductor.....	0.3958	lb.
Total copper in line, per K. W. delivered	391.9	lbs. *
Approximate loss of energy in line.....	0.862	K. W.
Approximate energy delivered at Niagara terminals..	1.926	"
Approximate energy delivered at Niagara turbines.....................	2.048	"

Cost of 1.926 K. W. generator at Niagara at $13.888 per K. W............... ..	$26.750	per	K. W.
Cost of 391.9 lbs. of copper in lines....	48.987	"	"
One kilowatt motor at Albany @ $14.953	14.953	"	"
	$90.690	"	"
Cost of 330 miles of line at $1,000 for 15,000 K. W........	22.000	"	"
Total investment per. K. W. delivered..................	$112.690	"	"
Annual cost of interest, depreciation and repairs at 10%...........	11.269	"	"
Cost of 2.048 K. W. at turbine shafts @ $4	8.192	"	"
	$19.461	"	"

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1. *Transactions*. American Institute of Electrical Engineers, March, 1893, Vol. X, p. 154.

2. *Journal*, Institution of Electrical Engineers, Vol. XXII, No. 108, Dec. 1893, p. 615.

3. *Ibid*, p. 516.

4. *Ibid*, p. 495.

Brought forward	$19.461 per K. W.
Labor, superintendence and general expense	2.681 " "
Annual cost of delivery of one K. W. at sustained full load	$22.142 " "
At average of 60% of full load, $27.53 per H. P. or	$36.903 " "

SYRACUSE.

Distance, 164 *miles; Maximum delivery*, 7,500 K. W.

For a delivery with full load at motor shafts of	1.000 K. W.
The delivery at line terminals	1.064 "
And with a power factor of 0.9, the received current on each conductor is	0.01931 amp.
Copper per mile on each conductor	0.3958 lb.
Total copper in line, per K. W. delivered	194.8 lbs.
Approximate loss of energy in line	0.4286 K. W.
Approximate energy delivered at Niagara line terminals	1.4926 "
Approximate energy delivered at turbine shafts	1.588 "
Cost of 1.4926 K. W. at Niagara @ $13.888 per K. W.	$20.780 per K. W.
Cost of 194.8 lbs. copper in line @ 0.125	24.350 " "
Cost of one K. W. motor at Syracuse @ $14.953	14.953 " "
Total	$60.083 " "
Cost of 164 miles of line @ $1,000 for 7,500 K. W.	21.87 " "
Total investment	$81.903 " "
Annual cost of investment at 10%	8.190 " "
Cost of 1.588 K. W. at turbine shafts @ $4	6.352 " "
	$14.542 " "
Labor, superintendence and general expense	2.681 " "
Annual cost at sustained full load $12.85 per H. P., or	17.223 per K. W.
Annual cost at 60% full load, $21.414 per H. P., or	$28.705 " "

BUFFALO.

Distance, 15 *miles; Maximum delivery*, 22,500 K. W.

For a delivery with full load at motor shafts of	1.000 K. W.
The delivery at line terminals	1.064 "
And with a power factor of 0.9, the received current on each conductor	0.01931 amp.
Copper per mile on each conductor	0.3958 lb.
Total copper in line per K. W. delivered	17.82 lbs.
Approximate loss of energy in line	0.0392 K. W.
Approximate energy delivered at Niagara line terminals	1.1032 "
Approximate energy delivered at turbine shafts	1.174 "
Cost of 1.1032 K. W. at Niagara, at $13.888 per K. W.	$15.320 per K. W.
Cost of 17.82 pounds of copper in line at $0.125	2.228 " "
Cost of 1 K. W. at Buffalo, at $14.953 per K. W	14.953 " "
	$32.501 " "
Cost of fifteen miles of line at $1,000 for 22,500 K. W.	0.667 " "
Total investment	$33.168 " "
Annual cost of investment at 10%	3.317 " "
Cost of 1.174 K. W. at turbine shafts at $4	4.696 " "
	$8.013
Labor, superintendence and general expenses	2.681
Annual cost at sustained full load $7.978 per H. P.	$10.694 per K. W.
Annual cost at 60% full load $13.296 per H. P.	$17.823

SUMMARY.

Cost of delivering a max. of 22,500 K. W. at Buffalo		@	$10.694	$240,610
Cost of delivering a max. of 7,500 K. W. at Syracuse		@	17.223	129,170
Schenectady	7,500	@	21.260	159,450
at Albany	15,000	@	22.142	332,130
different points	15,000	@	17.830	267,450
	67,500			$1,128,810

Average cost of delivery, full load	$12.475 per H. P.	$16.723 per K.W.
Average cost of delivery 0.6 full load	$20.792 per H. P.	$27.872 per K.W.
By Emery's tables the cost of generating steam power per annum with coal at $3 per ton is for 308 *days of ten hours*	$25.27 per H. P. and	$33.88 per K. W.
365 days of 20 hours	$44.43 per H. P. and	$59.56 per K. W.

This is with large triple expansion compound engines.

CONCLUSION.

The foregoing results indicate that on the basis of prices and voltages assumed and detailed, the power of Niagara Falls can be transmitted to a radius of 200 miles, cheaper than it can be produced at any point within that range by steam-engines of the most economical type with coal at $3 per ton. That Niagara power can maintain at Albany a large day and night output cheaper than steam engines at Albany can develop it, but that for power taken at Albany for 10 hours per diem the best steam engines have somewhat the advantage over Niagara unless exceptionally favorable conditions of load could be secured for Niagara power.

These conclusions are, of course, entirely dependent upon the reliability of the prices, voltages and estimates as detailed above. The prices, however, appear to be conservative, and are probably in excess of the latest market values. This would also appear from the statement recently published that the Cataract Construction Company has contracted for the privilege of right of way for conducting lines along the Erie Canal banks, by supplying power for barges at the annual rate of $20 per H. P. ($26.81 per kilowatt) whereas the above figures make the average cost of production $20.792 per H. P. ($27.872 per K. W.) on the basis of an average output of 0.6 full load; so it would appear that the Niagara Power Company are in the possession of better prices. Moreover, if the voltage delivery on the long lines, here taken as 35,350 at the receiving end, can ever be safely increased, a marked reduction in the cost of delivery would naturally result.

The broad conclusion to which an inquiry of this nature inevitably leads, is that while under ordinary conditions the commercial limit of electrical transmission of power from water powers of less than 500 kilowatts can hardly exceed fifty miles, the radius at which it will be profitable with good fortune and management, to electrically transmit a water-power aggregating 50,000 K. W., or more, is, perhaps, to-day, two hundred miles, and that it might be commercially advantageous for such a large water power to undersell large steam powers at twice this distance with no profit, in order to reduce the general expense upon delivery nearer home. The reason for this difference in the transmission radius between small and large water powers, lies obviously in the fact that electrical and hydraulic machines can be built and purchased much more economically in large sizes than in small, so that the cost of producing and of maintaining one kilowatt is very much less for large than for small water powers.

LABORATORY OF HOUSTON & KENNELLY,
PHILADELPHIA, April 18, 1894.

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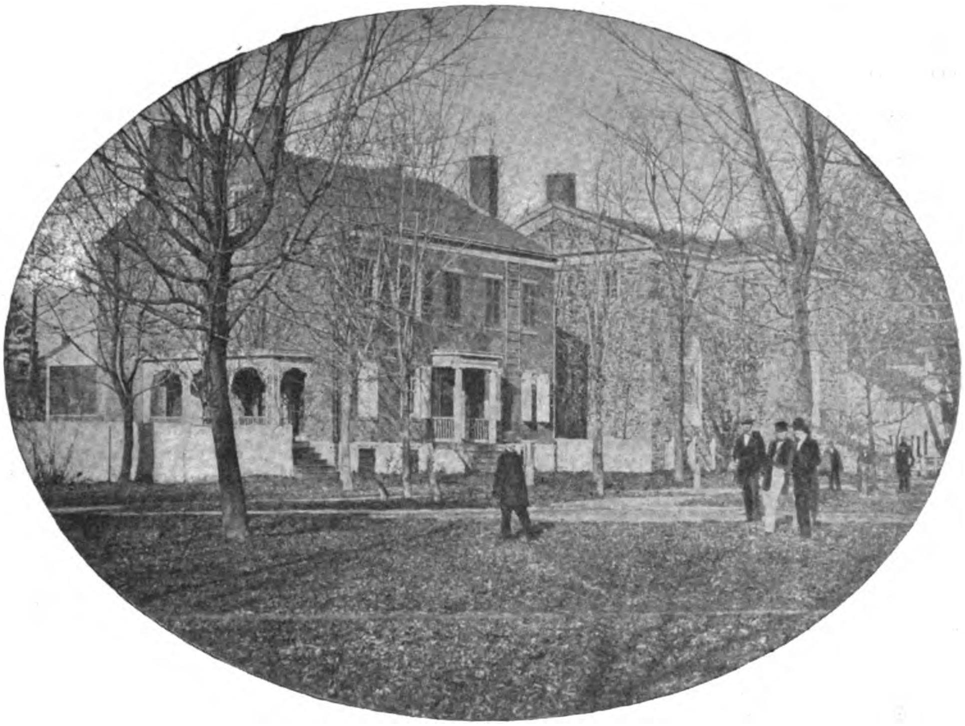
*The number of wires in the lines to Albany would be nine, about No. 000 B. & S. gauge, three on each main conductor.

THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—XI.

BY

Mary A. Henry

We hope the reader is not tired of Henry's electro-magnets. A little more we have to tell about them. In 1832 Henry left the Albany Academy to accept a professorship in the College of New Jersey, and in Princeton he made his last and largest magnet. It was called "Big Ben" by the students. It was made in 1833, and when a big battery, commenced the same year as a companion for it, was completed, it was made to lift upwards of six thousand pounds. It took a prominent part in Henry's lectures, which were not only attended by the students of the college but by the élite of the town. In these days the power of the electro-magnet has ceased to excite surprise, but very wonderful it seemed to Henry's delighted audiences when he made his bar of iron lift and drop heavy weights. Sometimes, as in Albany, he suspended a haymaker's scale to the armature and several of the young men standing in it were sustained by the attractive power of the magnet; sometimes also, as in Albany, breaking the connection with the battery and suddenly reversing the galvanic current, he allowed the armature with its weights attached to drop a little, to be caught back by a sudden reversal of the galvanic current or suspended in mid air, —an experiment which always excited great applause. There was no end to the ways in which it pleased Henry to exhibit the strength of his great magnet.



Henry's House, Princeton College, Sixty Years Ago.

In 1846, ten years later, a reference to this magnet was made in the book in which Henry recorded his experiments.

> LIFTING POWER OF THE LARGE MAGNET CONSTRUCTED IN 1833.
>
> Tried to-day the lifting power of the large magnet belonging to the apparatus of the college, constructed by myself in 1833. This lifted at the time of its first construction 3,600 lbs. with the large battery of 88 zinc plates, arranged as 4 plates; but I had supposed that the insulation had been injured by some accident in moving the apparatus.
>
> In this, however, I was mistaken, for it was found on trial to-day that it was still capable of sustaining 3,500 lbs. The estimation was roughly made, but the sum stated is within the truth. Eighteen men stood on the plank placed across the scale pole and three men pressed by their weight on the end of the iron lever.
>
> The magnet, in this experiment, was excited by two parts of the large plate battery arranged as one piece. The acid was very strong and formed at least $\frac{1}{10}$ of the liquid. When the poles of the battery were disconnected, or in other words, the galvanic current broken, the magnet sustained for a few minutes upwards of 1000 lbs. The same retaining power supports the keeper from year to year, and between 200 and 300 lbs. pressure is required to pull off the iron after it has remained in contact for 12 months.
>
> I have never published an account of this magnet, although it is the most powerful yet made.
>
> This magnet exhibits the curious phenomenon of persistence in polarization. If it be magnetized, so that, say, the right leg is a north pole, and afterwards the current be changed so as to make the same leg a south pole, after the current is stopped the first polarity returns, although the action may have been very intense.

If "Big Ben" exhibited well the power of the magnetism its maker could produce, it was used in a way so important in its bearing, not only upon the telegraph, but other magneto-mechanical contrivances, that we must ask for it especial attention. First should be remembered the difference between the two magnets Henry made; between the *intensity* magnet with one long thin wire, influenced by an intensity battery of many plates—which possessed the subtle power of being influenced at a distance—and the *quantity* magnet of many separate coils of thick wire, influenced by a battery of a single pair of plates, which was much more powerful, but not affected at a distance. Henry conceived a method of combining the individual qualities of the two brothers. When the weaker, sensitive, intensity magnet received the distant message he made it call into action the stronger quantity magnet by a simple expedient. He says this "consisted in opening the circuit of my large quantity magnet in Princeton, when loaded with many pounds weight, by attracting upward a small piece of movable wire by means of a small intensity magnet connected with a long wire circuit. When the circuit of the large battery was thus broken by an action from a distance the weights would fall and great mechanical effects could be produced; such as the ringing of church bells at a distance of a hundred miles or more. I frequently illustrated the principle of transmitting power to a distance to my class, by causing a thousand pounds to fall on the floor my merely lifting a piece of wire from two cups of the mercury closing the circuit." Mr. Dickerson says:

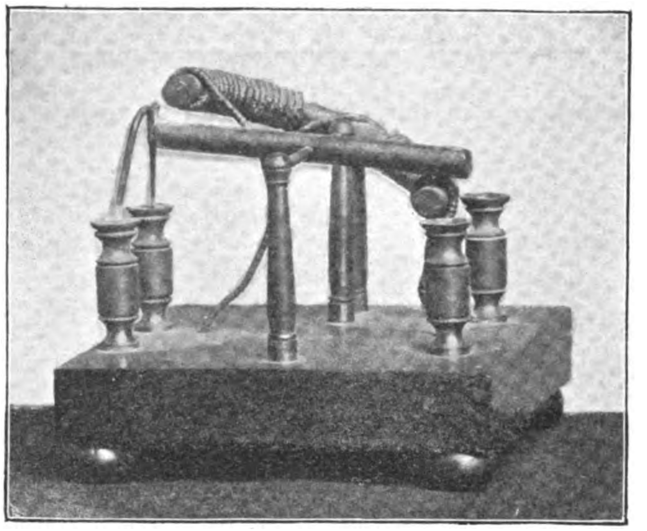
"Of the utmost importance has this combination proved to the telegraph—its principle underlying all the various forms and uses of the relay magnet and the receiving magnet and local battery since employed. He thus made the powerful magnet at short range the servant of the weak one at long range, and left the problem (of the telegraph) entirely solved to those who could procure the money to apply his discoveries to the commercial uses of man."

The following is another quotation from Henry in regard to the arrangement described:

> **The local circuit devised by me was connected with a quantity battery and large electro-magnet, loaded with several hundred pounds. When the ends of a fork-shaped wire were drawn up from the surface of mercury, contained in two cups (thimbles were used), the circuit was broken, and the weights fell to the floor. This part of the combination and action was actually and repeatedly exhibited in my lectures at Princeton, from 1833 to 1848. I also accompanied the exhibition with the statement that the same effect could be produced by the action of a battery at a distance for ringing bells and other mechanical effects. The results of my first experiments in causing an electro-magnet to act through a long wire furnished me with the means of accomplishing this. For this purpose it was only necessary to attach the forked wire to the armature of a small intensity magnet connected with the long circuit, in which was also an intensity battery. When the current was passed through the long wire the armature would be attracted upwards, the short circuit would be broken and the weight would fall. I do not recollect to have exhibited the last part of this arrangement in my lectures, or remember when I invented it, but the invention was made and explained before the publication of Mr. Morse, relative to the telegraph. The object of this invention was to illustrate the production of a mechanical effect at a distance, by means of a long circuit being made to open a short circuit. From my previous experiments, in the transmission of electricity through long wires I was well aware of the fact that I could not cause the large quantity magnet to act by a battery at a distance directly through a long wire, and hence the necessity of this invention to produce the effect which I always stated I could produce.**

Henry used his contrivance for the opening of the circuit of his great magnet by means of another magnet and circuit as early as 1833; that is, very soon after the great magnet was made. The instrument he used to exhibit his device was in my possession until a short time ago, it is now in the National Museum. (The picture given of it is from a photograph.) It consists, as the reader may see, of a metal rod, suspended so that it can move freely, and ending in a wire fork. The ends of this fork are seen dipping into mercury cups, and they thus closed the circuit of the large magnet. When the circuit of the small electro-magnet, seen in the picture, was formed, and the magnet excited by an electrical current, it attracted upward the end of the metal rod carrying the fork, the ends of the fork were lifted out of the mercury cups, and the circuit of "Big Ben" was broken. Then the great magnet dropped the three thousand pounds it was holding, while Henry explained that the little bar with its fork could be lifted up in exactly the same way by a magnet in a long circuit, and thus the great power obtained by the dropping of the heavy weights might be called into play for mechanical purposes at a distance. Henry is not sure when he actually opened the circuit of "Big Ben" by means of a long intensity circuit, but this does not matter; he did not need to prove at this time that his intensity combination could lift that little fork as easily at a distance as a short circuit could lift it there in his laboratory; he had been showing its power to produce such an action at a distance since 1830. What concerns us to know is: that as early as 1833 he conceived the device exhibited by this little instrument, of opening one circuit by means of another, and distinctly explained that it could be used, with his intensity combination, to bring into play great power at a distance; his object in making the device was to show this.

The significance should be distinctly understood of what Henry accomplished when, there in his Princeton laboratory, he showed, how the great strength of his powerful quantity magnet could be called into action at a distance by means of the subtle susceptibility of his more sensitive intensity magnet in its long circuit. He had made his intensity magnet deliver the distant message of the telegraph, he had given his little machine to show how the distant electro-mechanical effects could be used in other ways—and now he had shown how very great was the power which might be called into action at a distance.



HENRY'S CIRCUIT BREAKER.

I quote again from Henry:—

> **"The only other scientific facts of importance to the practical operation of the telegraph, not already mentioned, are the discovery of Steinheil, in 1837, in Germany, of the practicability of completing a galvanic circuit by using the earth for the return conductor, and the construction of the constant battery in 1836, or about that time, by Professor Daniell of King's College, London. I believe that I was the first to repeat the experiments of Steinheil and Daniell in this country. I stretched a wire from my study to my laboratory, through a distance in the air of several hundred yards, and used the earth as a return conductor with a very minute battery, the negative element of which was a common pin, such as is used in dress, and the positive element the point of a zinc wire immersed in a singe drop of acid. With this arrangement a needle was deflected in my laboratory before my class."**

Henry stretched a wire, in accordance with the above arrangement, across the college grounds immediately after his return from a trip to Europe in 1837. He used the wire every year after until he left Princeton, in a certain part of his course of lectures, to show his classes how communication could be held at a distance by means of electricity, receiving and answering, in his laboratory, messages from Mrs. Henry, stationed in the study of his dwelling house across the college grounds. The Rev. M. B. Grier lets us see him still using it in this way five years later :—

> In the winter of 1842–43 I was a student in the Theological Seminary in Princeton, N. J. I was in the habit of visiting occasionally in the home of Joseph Henry, then Professor of Natural Science in the College of New Jersey. One evening, when I was leaving the house, Prof. Henry gave me an invitation to attend the Course of lectures which he was delivering, I believe to the Junior Class of the College. I readily accepted the invitation and was often present in his lecture room. At the close of one of his lectures, I remember that he gave notice that he would, on the next class day, demonstrate the practicability of using the magnetic current as a means of communication between two persons at a distance from each other. The next lecture was fully attended by the class and by all who had the privilege of being present by invitation. I noticed that a wire was passed through one of the upper windows of the laboratory, which ran along the ceiling, then dropped about half way to the floor and was there put in communication with a triangle (or, as some say, a bell). The professor introduced the demonstration with an exposition of the scientific principles which he was about to illustrate and then informed the class that he would communicate with a person stationed in his study, in his own home, which was on the other side of the campus, and which was distant from the point where he stood probably one hundred and fifty yards. He made a communication as he announced, and the whole class turned their eyes to the triangle to watch for the response from the person stationed in the Professor's study, understood to be Mrs. Henry. We waited in earnest expectancy for three or four minutes, when the little triangle rang out the news that the Professor's signal had been received at the other end of the wire, and an answer returned. As the rapid sounds came from the triangle the demonstration seemed to be so complete that the class broke out into applause. Prof. Henry simply remarked that the possibility of transmitting messages by the use of the magnetic current seemed to be established.
>
> This is my recollection of a very interesting scene in the Professor's classroom.
>
> M. B. GRIER.
>
> PHILADELPHIA, August, 1893.

AULA NASSOVICA. 1760.

"OLD NASSAU" IN 1760.

The following is a letter to the Rev. M. B. Grier, dated Madison, Wis., Aug. 25th, 1893.

> I remember the event you describe and often recall it with much interest. I am not positive whether a bell or a triangle was used, but think it was the latter. It was Mrs. Henry, who answered the call. It was at that or a succeeding lecture that Prof. Henry stated, with evident satisfaction, that a wire for the return current was not needed and proved it, by having one end of the single wire end in the well at the laboratory building (Clow's refectory also) and the other end of the wire in the well of his home.
>
> I am sorry, that I have not preserved my full notes and drawings of Prof. Henry's lectures. I yet feel something of the thrill that went through us at that (then wonderful) experiment of the great philosopher. Very fraternally yours,
>
> A. V. C. SCHENCK.

Henry continued in Princeton not only the developement of his magnets and his contributions to the telegraph ; his researches in regard to electrical induction were also continued. He resumed the subject of the extra current in 1834, experimenting again with wires long and short, coiled and uncoiled, and also with flat ribbons of metal. If we could go back to certain summer days, somewhere about this time, we would find Henry in the pleasant college ground flying kites. "From the clear blue sky, with two kites, one above, assisting the other, held by a delicate wire wound on an insulated reel," he drew down streams of brilliant sparks, intensified by the self induction of the wire itself. With some coils of insulated copper ribbon (now at Princeton) he discovered that one induced current could induce another and that another and so on ; also that a current of *quantity* could produce one of *intensity ;* also that these currents could be induced at a distance. He obtained currents in his lecture hall, induced by primary currents obtained in an adjoining room, "*with no connection, merely by the disturbance of the electrical plenum*" I use his own words, taken from letters to friends. He obtained the same result between an upper room of the Philosophical Hall and the cellar of the same building, receiving shocks in the cellar from the induced current. In this case there were two floors and ceilings intervening. Then he stretched two parallel wires across the college grounds, several hundred feet apart, to find that an electrical current in one would exite an induced current in the other. Finally he turned the roof of his house into an induction plate and magnetized needles in his study by induction from a thunder cloud *eight miles away*, the storm thus telling him of its approach while yet the sky was clear. These experiments are given in the laboratory books in which he recorded his experiments. "There is a device in operation by which telegraphic communication is kept up between running cars on railroads and the stations, so that the positions of all the trains may be at any time known, and protection against collisions be assured. For this purpose the metallic roof of the car is used as an inductive plate, just as was the roof of Henry's house, and a wire passes from it through a signaling coil to the ground by way of the metal wheels and track. Near the roof outside an electric wire is stretched on poles, through which electric flashes are sent, and they set up by induction in the roof electrical currents similar to those passing in the wire, which are read as signals by the observer; and conversely signals are sent from the roof to the wire, by induction coils in the cars. Thus the effects obtained by Henry long ago now throw a safeguard around our lives."[1] The comparatively recent projects for telegraphing across streams by means of electrical induction, with, to use Henry's words, "no connection, only by the disturbance of the electrical plenum," have received deserved attention. The storm sent its telegraph message to Henry in this way in 1842, a distance of eight miles.

INTRAMURAL CARS FOR BROOKLYN.

THREE of the motor cars of the World's Fair Intramural Railway have been purchased by the Atlantic Avenue Railway Company of Brooklyn. They will be remodeled to the extent necessary to operate them as trolley cars, and will be used to haul open cars from Thirty-ninth Street Ferry to and from Coney Island, obviating the employment of locomotives.

The cars, it will be remembered, have each a seating capacity for ninety passengers, and will draw four passenger cars of equal capacity.

The cars will be put in service shortly before the opening of the regular season, and if they are found to answer the purpose it is probable that additional purchases will be made by the company.

---

[1] E. N. Dickerson "Henry and the Telegraph."

TESTING FOR GROUNDS ON INCANDESCENT CIRCUITS.

BY

Austin S D Latch

AFTER reading Mr. G. L. Thayer's article on "Grounds on Incandescent Circuits," in the ENGINEER, of April 11, I send you a method I have used for about five years and think it will commend itself to your readers, as no lights are disconnected in locating the ground. With slight modifications, the system can be adapted to alternating, as well as direct current, and either isolated or central stations. I devised the method from some experiments made by Mr. M. M. Waddell, of the Waddell-Entz Company, and myself, at the Edison station, in Detroit, in our attempt to locate grounds on the underground system by other than the "cut and try" method.

The mechanical stokers in that station are run by a small engine, with the ordinary ball governor. We used this governor to interrupt the current from a bank of lamps, as shown in Fig. 1. An iron arm is fastened to the governor frame; this carries a block of wood, on which is a metal strip. The governor balls strike this strip and thus complete the circuit to ground through the engine. This gave an interrupted current through the system, from the ground to the station and, by carrying an induction coil with a telephone receiver over the wires, we were able to follow in the direction of the ground.

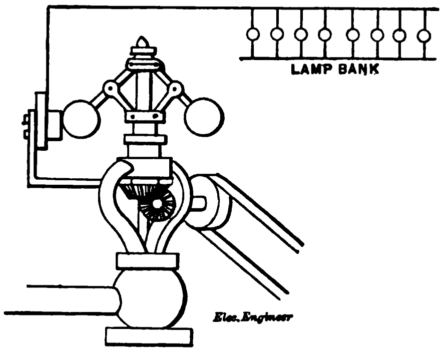


FIG. 1.

My method is a modification of this. I divide the system into sections and with auxiliary bus bars can test each section without putting out the lights. After locating the section, I would try the inside wiring with the device shown in Fig. 2. This consists of an induction coil with a receiver connected to the fine wire terminals and a non-inductive resistance with an interrupter. The primary of the induction coil has screw clamps for terminals so that it can be connected to each side of the cutout. The resistance coil R is connected from the other wire to ground. By removing the plug or fuse strip the current will pass through the induction coil. If the ground is in the building there will be a heavy induced current in the receiver; otherwise, only a slight hum caused by the direct current.

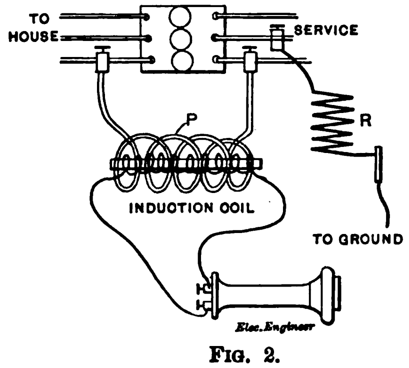


FIG. 2.

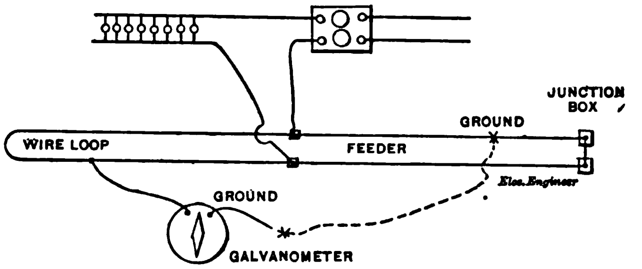


FIG. 3.

If the ground is in the building a few more such tests will easily locate the ground. Should the ground be found on the outside underground wiring it can be located without danger of producing fire; so putting on a load at the station the indicators will show which feeder it is near. A junction box can now be opened knowing that not more than one other will need be.

The first thing I do after opening the box is to test the feeder for ground, disconnecting of course. If it is in the feeder, I disconnect both in the station and junction box; then connecting the terminals together in the junction box I measure by the ordinary sliding bridge method, as shown in Fig. 3. This is simply a Wheatstone bridge and the point in the wire loop where the galvanometer is connected when the needle comes to rest will divide the loop just as the ground divides the feeder.

Should the ground be in the mains I use the same method as in inside testing only using a heavier interrupted current, since the ordinary current is heavier. After locating the main and disconnecting so that it feeds from one end only, I put as heavy current through the ground as is safe without burning the smallest service, should the ground be in it. I now measure the voltage across this load and simultaneously at the services. The voltage across the load will be the same as that of the two services on each side of the ground. This is shown in Fig 4. A, B, C, D, E, F, are services; the voltage at M across the resistance is the same as at F and possibly a little less than at E since the current in passing through to the ground and back to K will produce an appreciable drop in the wire from K to the ground; but the services F, G, H, will remain the same as M, as the testing is made when the load is light.

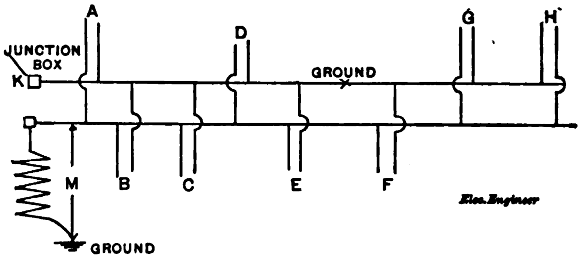


FIG. 4.

With the induction method 5 amperes is a large current and usually 2 or 3 is enough, depending on the normal current in the line If the ground be in a cord or fixture this current will blow the fuse without any danger of fire. I do not advise a lamp bank for a testing resistance as it will attract attention, while a non-inductive resistance coil will give the appearance of connecting a telephone on the line "to hear the flow of the current." With overhead lines only the inside tests need be made as a good inspector usually knows his faulty spots and where to look first.

This may seem to be a long, roundabout method if the cut and try method has been used. But usually with two men, and often only one, I can locate the ground as soon as two men will by the "guessing process." Even if it took twice as long or cost twice as much, I would still advise the above method. I believe too much emphasis cannot be put on the importance of uninterrupted service either isolated or central station. One disconnected service costs ten times the apparent saving even if disconnected only for a moment, and it may cost a good customer. I believe the principal cause for the opinion of instability in electric lighting is due to the habit of employés indiscriminately disconnecting customers for testing purposes.

Of course we are avoiding grounds now by our better methods of wiring, both inside and out, than were employed five, or even three years ago; still we have them and that shows we cannot be too particular in watching our insulation resistance records. On arc circuits Rudd's method is the best; but for Edison or other multiple arc systems I think a modification of Mance's method for measuring a resistance containing a potential difference or else using two voltmeters at once is to be preferred. I do not think much of measuring the resistance when the wires are idle but want the condenser effect.

CONNECTING FIELD MAGNETS TO BUS BARS.

BY

C. S. Van Nuis

Mr. A. B. Herrick, in his paper on "Switchboards for Modern Central Stations," read before the National Electric Light Association at Washington, states that "the proper method of exciting dynamos is still an open topic," and, after mentioning some of the advantages and disadvantages of both the bus exciting and self exciting methods, dismisses the subject without throwing much light on the solution of the problem.

It will be seen, from Mr. Herrick's statements of the relative merits of the two methods described, that the chief advantages in favor of bus excitation appear at the time of starting the dynamos, while the self exciting method has the ascendancy at the time of shutting down. Believing that neither system, alone, would be thoroughly satisfactory in a large station, especially where busses of different potentials are used, the question naturally arose, Why not devise a system of shunt connections, which combines the advantages of both?

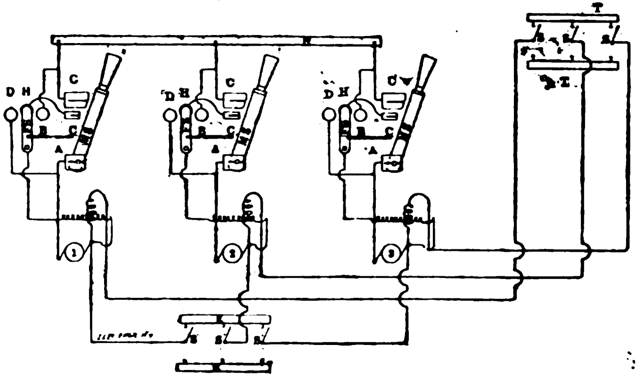
This may be accomplished in a very simple manner, by connecting the field wires of a dynamo to the middle contacts of a double throw switch, the end contacts of which are to be connected, the one to the dynamo leads and the other to the bus leads of the main switch. This double-throw field switch should be so arranged that it may be optional with the operator whether the dynamos shall be started with a bus or self excited field, but *always* to shut down with the switch in the position of the latter connections, independent of any act or neglect on the part of the operator.

This system will be easiest illustrated by the accompanying diagram of connections of a single pole switchboard, as used in the latest improved electric railway construction, in which 1, 2 and 3 represent generators; R, the rail bus; T, (upper) the 650 volt trolley feeder bus; T, (lower) the 550 volt trolley feeder bus; E, and E' the high and low potential equalizer busses respectively. S and S' are double-throw switches, used to connect any generator to either the high or low potential busses. This is done before starting the generator, so that when field switch F S is closed on either B, the the bus connection, or D the generator connection, there will be a complete circuit for bringing the field to the required degree of saturation..

If the field switch, F S, should be closed on the point D, the generator would be self exciting, and the closing of the main switch M S would not alter the position of F S; so the generator would be, in this case, self exciting, both in starting and in shutting down. If, however, F S is placed on the contact B, the generator will be bus excited in starting, but will be shut down with a self excited field; because the arm, A, on the field switch F S will be in the path of the main switch M S, and the act of closing the latter will force F S to its former position at D.

The field switch shown differs from an ordinary double throw switch, only in one particular; between the contacts B and D there is a third contact H, which remains uncharged, or neutral, except when the main switch blade M S engages the contact C, at which time the lower auxiliary clip C derives current from the main switch blade, charging the middle contact H, and there will be no difference of potential between any parts of the field or main switches, and the blade of the field switch may move from the contact B to D, without interrupting the shunt circuit.

It will be seen from the above description that the field switch may be moved from the contact D to P without short circuiting the main switch, yet in traveling the reverse way from B to D, the gap is bridged by the third point and no break occurs. In double pole construction, the field switch should also be double pole, or a field switch to each main switch blade.



Connecting Field Magnets to Bus Bars.

In the April 11 issue of The Electrical Engineer, Prof. Anthony describes a method of discharging dynamo fields, by the use of a special rheostat, which would appear to satisfactorily dispose of the field discharge, but at the expense of a troublesome factor in the rheostat.

An extended experience with electric railway switchboards has confirmed my belief, that when equipping a board for high potentials, there is always safety in increased distances between opposite poles of a circuit, and that single pole apparatus is usually preferable to double pole for such purposes.

The special rheostat shown in Prof. Anthony's sketch, does not eliminate the field switch, but combines it with the rheostat in such a way as to bring the opposite poles of a circuit into dangerous proximity; and, if the advantages to be derived from self excited fields are to be utilized, or more than one potential is to be used on any system of current distribution, an additional field switch must be installed. If then, the field switch is essential to a high degree of flexibility in such a plant, why not use field switches and rheostats of one polarity? The short circuiting device will not be required for the field discharge, if the dynamos are made self exciting at the time of shutting down, for the field will gradually die away as the armature decreases in speed.

ELECTRIC TRANSPORTATION DEPARTMENT.

NEW WESTINGHOUSE RAILWAY MOTORS AND CONTROLLER.

The Westinghouse Company has issued a beautifully illustrated catalogue (No. 55) from the artistic press of Bartlett & Co., describing the railway motors, Nos. 10 and 12, which the company was led to bring out nearly a year ago to meet the demand for a lighter motor, and so mounted as to bring less weight upon the car axles.

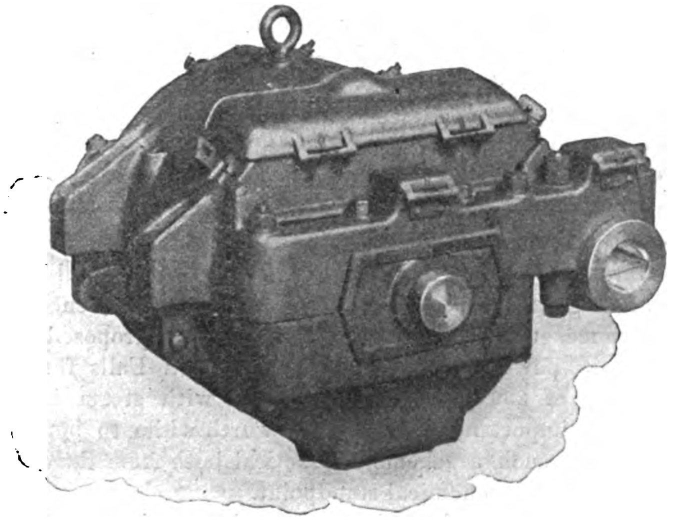
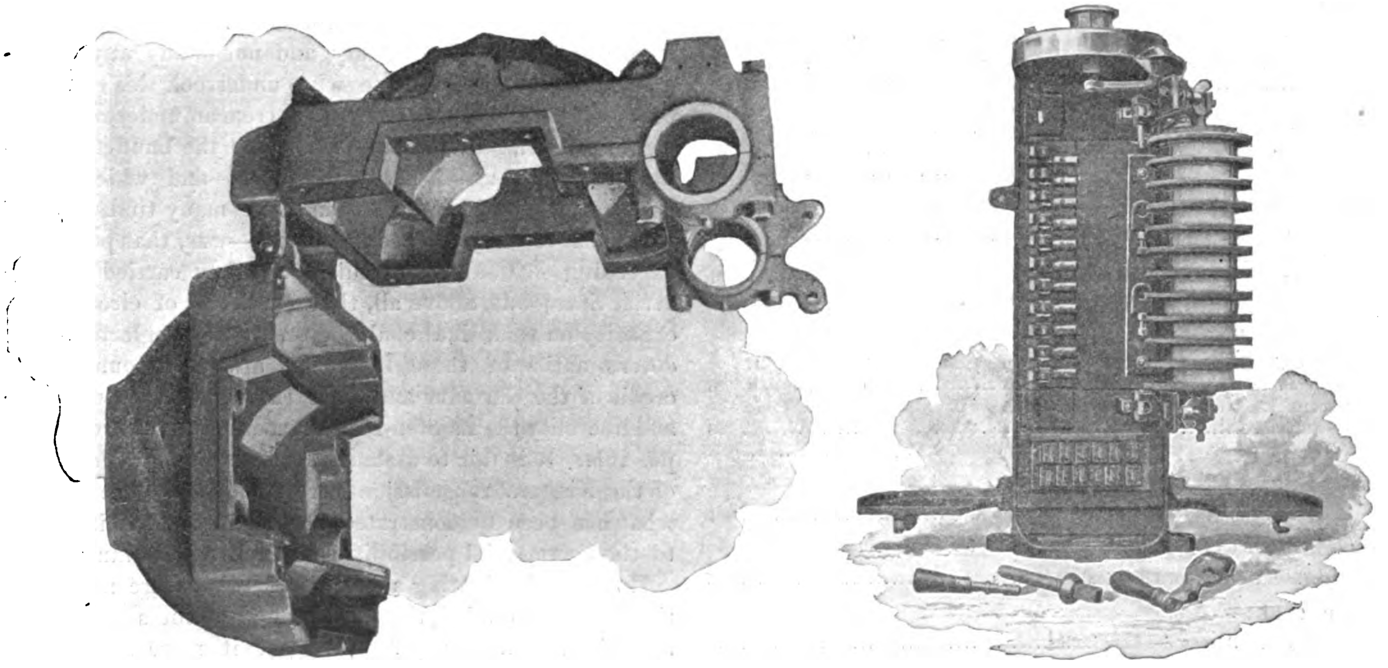


Fig. 1.—New Westinghouse Railway Motor.

The new motor, as shown in Fig. 1, appears to resemble the well-known No. 3 single reduction motor without the iron frame which serves as its support. The absence of this frame reduces the weight of the new motor without diminishing its rigidity. As the company considers that a circular form of field affords the greatest strength for any given weight of material, that a four-pole field gives greater output than one of only two poles, and that the toothed armature, with a two circuit winding and lathe wound coils, has been practically demonstrated to be unsurpassed, all these features of the No. 3 type of motor are retained in the newly designed machines, which are manufactured in sizes ranging from 20 to 50 h. p.



Figs. 2 and 3.—New Westinghouse Railway Motor Castings and Controller.

The rectangular frame, which was a distinct feature of the No. 3, has been incorporated into the upper half of the field of the No. 10 and No. 12, so as to do double service, forming a part of the magnetic circuit and a part of the frame, and thus giving sufficient strength to the motor to hold the armature shaft always in perfect alignment with the car axle. On the side which is farthest from the axle of the car, the two halves of the yoke are hinged together, so that the interior parts of the motor are made easily accessible without the necessity of dismounting.

The lower field casting has three openings, one directly below the commutator and the others at opposite ends of the casting. These openings are closed by water-tight covers, which may be removed to give access for the purpose of repair or removal of dust or dirt. Fig. 2 shows the arrangement of the frame castings, from which it will be seen that the armature may be held in either the upper or the lower field, as desired, when the motor is opened for repairs or inspection.

Fig. 3 shows the new No. 14 series multiple controller. The drum is so supported that it can be swung clear of the contacts, the supports of the two bearings of the drum shaft being hinged at one side of the controller back. In this way ready access to the drum and contacts is secured.

The controller is made both fire and waterproof. The cover of sheet iron, lined with asbestos cloth, is easily and quickly removed. The drum is built up of thick porcelain and vulcabeston rings, the latter extending sufficiently beyond the porcelain to render arcing from one contact to another impossible. By raising the points of arcing above the surface of the insulator, any tendency to disintegrate the porcelain is avoided. The contact strips are made with replaceable tips. At the left of the drum are placed the contact blocks, which resemble short, thick fingers split diagonally into two sections, to secure perfect contact and even wear. The two plugs placed at the right of the frame enable either motor to be cut out of circuit, by the removal of either plug, rendering unnecessary the use of the usual cut-out box within the car. The controller has a double back in which are the wires and connections, so that any danger from grounds or short circuits within the controller is avoided. The reversing handle projects from the side of the stand. A single throw of this switch reverses the current in both motors. The controller throughout is of the best workmanship and the parts subject to the greatest wear can be quickly and cheaply replaced.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - -	per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies, - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

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THE DISTRIBUTION OF NIAGARA'S POWER.

THE rapid strides which the Cataract Construction Co. and its allied companies are making towards the completion of the greatest power plant in the world have given rise to much speculation as to the ultimate limit of distance to which the power of Niagara can be economically transmitted. Renewed interest has been awakened on this point by the consummation of a contract between the State of New York and the Cataract General Electric Co., by which the latter undertakes to furnish electric power to canal boats all along the Erie Canal, at a cost not to exceed $20 per horse power per annum. Granting even that the power would be utilized only during little more that seven months during the year, the cost agreed upon must have struck many engineers as being exceedingly low. Of course we must also take into consideration the fact that the part of the contract relating to canal boat propulsion may have been deemed of secondary importance as compared with the rights of way and privileges granted to the Cataract Company, and that on that account it could afford to grant some concessions. But making even this allowance, the very fact that it was proposed to transmit power electrically from Niagara Falls for a distance of 330 miles in competition with steam is of sufficient importance to render it worth while to inquire in how far such a scheme is practical both from the electrical and the economical standpoint.

In planning a project, the conservative engineer calls to his aid, as far as possible, previous examples of successful work, but if we look around for precedents in the present case, involving the transmission of tens of thousands of horse power for several hundred miles, we are literally confronted by a void. The nearest approach to such work is the Lauffen-Frankfort experiment in 1891, where some 200 horse power was transmitted 109 miles. We have used the word "experiment" advisedly, and not in any way to disparage the efforts of those who undertook this excellent pioneer work, but to distinguish it from an undertaking designed for commercial purposes. What the Lauffen-Frankfort experiment did show, however,—and which would have amply justified an expenditure many times that of the actual cost of the experiment,—was, that potentials exceeding 30,000 volts could be safely carried on bare aerial lines; but, above all, that the effects of electrostatic capacity on such lines could be practically neglected. The determination of these facts will always redound to the credit of the Germans and Swiss through whose enterprise and liberality the Lauffen-Frankfort experiments were made possible. It is fair to assume therefore that the promoters of the Niagara transmission were guided to some extent by what has been demonstrated abroad in their estimates as to the commercial possibilities of their undertaking.

However fascinating a project of this nature may be to the speculative mind, the hard headed business man is ever inquiring: Will it pay? or, to put it more specifically, Can Niagara compete with steam power in the cities along the Erie Canal, with coal at $3 a ton. This is the whole problem in a nutshell and in order to give our readers a clear understanding of it we print in this issue a most able and interesting contribution from Messrs. Houston and Kennelly, who at our request took up broadly, three or four weeks ago, the question of the economical limits to which Niagara power can be transmitted, and who work out several specific cases. It will be noted that, throughout, conditions of operation have been assumed for which there are good and sufficient precedents; and the selection of 35,000 volts pressure between conductors is so little in excess of that employed in some of the Frankfort-Lauffen experiments that there can be no reason for apprehending the action of a possible unobserved disadvantageous effect due to that cause.

In treating the case, the authors have reduced their calculations to the cost per horse power and per kilowatt, evidently the most logical method, and one permitting of the readiest comparison with existing conditions. They have also assumed that the conductors are to be carried on pole lines and that the 3-phase system is employed.

The figures representing the results of these calculations will, we are certain, be a surprise to many, and especially to electrical engineers, who have been perhaps the most conservative of all as to the effective distance of Niagara transmission. Messrs. Houston and Kennelly show that with a steady load of 24 hours per day, power can be delivered at Albany, a distance of 330 miles at $22.14 per kilowatt, which is cheaper than it can be produced by triple expansion steam engines. The general conclusion that under conditions and potential assumed, power can be transmitted in competition with steam to within a radius of 200 miles of Niagara with an average load of only 60 per cent. is of the highest significance; and, as suggested, that limit might be extended 200 miles further, providing the power transmitted aggregates 50,000 K. W. This brings the limit close to New York and Chicago, and in support of this statement we have the authority of one of the most eminent electrical engineers in the world for saying that 150,000 H. P. can be put down in New York from Niagara in competition with steam, under practicable conditions of electrical pressure.

The problem which Messrs. Houston and Kennelly have attacked is a large one, but we believe their results will bear close scrutiny, and we are, of course, glad to open our columns to a discussion of the problem by others. The far-reaching nature of the results foreshadowed in the article must be manifest. Besides the influence on electrical distribution for all purposes within cities, they will bring us close to the time when all the railroads within the economical zones must be operated by electricity. In short, it is scarcely possible to realize the extent of the impetus which will be given to electrical work should the facts bear out the calculations to which such men as Prof. Houston and Mr. Kennelly have subscribed their authoritative names.

CONDUIT RAILWAY SYSTEMS.

If the number of methods suggested for, be any indication of the interest taken in, conduit railway work, we shall soon find a solution of the problem adapted to the conditions existing in this country. Among the methods which are actually in experimental operation we describe this week the Lawrence system which possesses features apparently enabling it to cope with the most formidable difficulties of underground operation.

SOCIETY AND CLUB NOTES.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The Philadelphia Local Committee is making elaborate arrangements for the entertainment of members of the Institute who attend the coming Annual and General Meetings in that city. The social features are being especially arranged with regard to the attendance of ladies, and it is hoped that the fair sex will be well represented. This being the 10th Anniversary of the Institute, the rule of strict attention to business will necessarily be relaxed somewhat in order that members and guests may avail themselves of the proverbial hospitality of the City of Brotherly Love. In addition to the list of papers published last week, Dr. Louis Bell will present one upon "Some Facts about Polyphase Motors."

A brief outline of the preparations in progress prepared by Chairman Willyoung of the Local Committee, embraces the following functions:—On Tuesday, May 15th, Address of Welcome by Mayor Stuart, to be followed by the Annual Business Meeting and reading of papers. Mr. Wurts' paper on Lightning Arresters will be accompanied by experimental demonstrations at the station of the Philadelphia Traction Co. In the evening the Annual Dinner of the Institute and a theatre party for the ladies. Wednesday afternoon, a tally-ho excursion will be provided for the ladies and the Engineers' Club will tender a reception in the evening. Thursday afternoon will be occupied by a visit to Cramp's Ship Yard, followed by a steamer trip down the river to Gloucester where a shad dinner will be served.

Fuller details of the arrangements will be given in the official programme. Visiting members will be welcome to the office facilities of Messrs. Houston and Kennelly, Rooms 1,105–1,106 Betz Building, near the Penna. R. R. station, where letters may be addressed in advance of their arrival.

The Secretary of the Institute would deem it a favor if those who propose attending the meeting will write him to that effect at 12 West 31st St., New York City.

The Chicago meeting of the American Institute of Electrical Engineers was held at the Armour Institute on last Wednesday evening, April 25th. The meeting was very well attended, an audience of over sixty being present. Upon the motion of Mr. B. J. Arnold, Mr. Samuel Rodman, Jr., was made chairman.

The paper by Isaiah H. Farnham, presented at the 86th meeting in New York, was read by Mr. Arthur V. Abbott, of the Chicago Telephone Co. After the reading of the paper, which was profusely illustrated by lantern slides, Mr. B. J. Arnold opened the discussion, which was participated in by Messrs. Wells, Armstrong, Hibbard and others. A communication from Prof. Dugald C. Jackson, giving results of an investigation of the electrolytic action and chemical changes in iron plates immersed in the ground, was then read by the Local Honorary Secretary. The Local Honorary Secretary then offered a resolution, asking that a committee of three be appointed to communicate with the Institute in New York, touching the question of expenses of the Chicago meeting, which should come out of the general fund. The resolution was adopted.

Alderman Mann, of the Chicago City Council, being present, was invited to address the meeting upon the subject of overhead vs. underground trolleys, and expressed his views in some well chosen remarks. Mr. Mann, after expressing his gratification at having been able to listen to the very interesting paper, said that he did not believe electrical experts would ever agree upon the trolley question, and made the point that as long as a solid majority of the city council was in favor of the overhead trolley cars as a means of rapid transit, any underground scheme would stand little chance of being adopted in Chicago. He admitted that Chicago is much behind other cities in the way of rapid transit and thought the horse car lines should be abolished. Among other visitors were Messrs. F. S. Beach of the Chicago Telephone Co., Prof. M. O'Dea, of Notre Dame, and Geo. W. Knox, electrician of the Chicago City Ry. Co. On motion of Prof. Stine the meeting adjourned.

LITERATURE.

Annuaire du Bureau des Longitudes, 1894. Paris: Gauthiers-Villars & Fils. Price, 50 cents.

Besides the usual astronomical, nautical and miscellaneous tables contained in this annual there are a number of special essays, and among them the following: Light and Electricity according to Maxwell and Hertz, by M. Poincaré. The Origin and Employment of the Mariner's Compass, by Rear-Admiral Fleuriais. Four Days of Observation on Top of Mont Blanc, by M. J. Janssen. Addresses delivered at the Unveiling of the Statue of Arago, by MM. Tissandier, Cornu and Mouchez.

MISCELLANEOUS.

DESTRUCTIVE EFFECT OF ELECTRICAL CURRENTS ON SUBTERRANEAN METAL PIPES.[1]—II.

BY ISAIAH H. FARNHAM.

(Concluded.)

Seventh.—At about this stage in the study of the problem, Mr. Fred. S. Pearson, then engineer of the West End Street Railway Co., made two suggestions which, though separate in themselves, and presented at different dates, yet carried out in conjunction, have proved exceedingly helpful in overcoming the difficulty, at least so far as relates to telephone cables. It occurred to Mr. Pearson first, that if the railway current should be reversed so that the positive pole would be connected with the trolley, the danger of electrolysis would be removed from the greater and more scattered portion of the city, and be brought near the power station where it possibly could be more easily dealt with. This reversal was made and the expected potential changes between cables and earth followed. Fig. 8 is a map of Boston, showing the condition after the reversal of current. The red or dangerous portions in this map, correspond to the white or safe districts in the map, shown in the first of this paper (Fig. 3) the only variation being, that by the reversal, the natural or zero line was thrown out a little further from the Albany street power-house than it was located before. It was also noted that the cables near the power-house which had been from one to two volts negative to earth before the change of current, were now one to nine volts positive to earth; that is, they were raised higher above zero than they had been below zero prior to the reversal. Fig. 9 is a typical representation of the current flowing through trolley, car, rails and cables at this time. It will be readily understood that with the conditions as illustrated in this figure, the electrolytic action would be confined to the territory comparatively near the power stations where the current is leaving the cables to reach the negative or rail side of the dynamo.

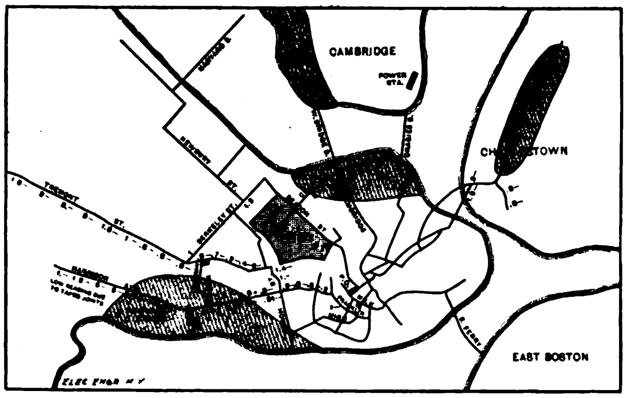

FIG. 8.

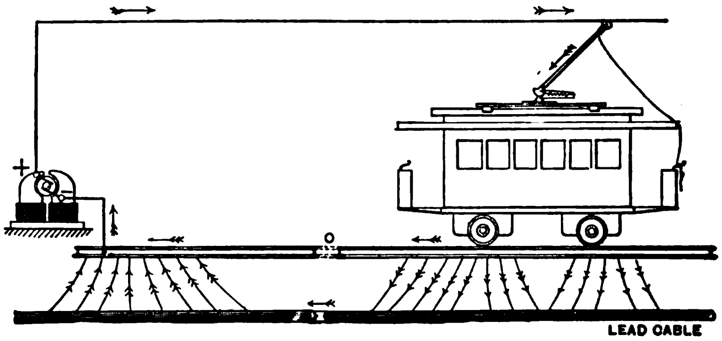

FIG. 9.

Mr. Pearson next suggested the plan of running out large copper conductors from the negative side of the dynamo and extending them through the dangerous district, connecting them at frequent intervals to the cables. Fig. 10 diagrammatically illustrates this plan. On the principle involved in Prof. Thomson's motor generators, this low resistance conductor connected directly to the dynamo, was to pump the current from the cables and so prevent its passage into or through the moist earth. Some of us were skeptical as to the completeness of this proposed remedy. It seemed possible that even with such a good return conductor, some of the current might still pass into, and through the earth. Voltage measurements, however, at once dispelled the doubts, for we found that the cables measuring 9 volts positive to earth, gave a reading of 22 positive to the return conductor; that is, the return wire, as relating to the cables, was at all points more negative than the earth (if we may be allowed the expression). The return conductors were made up of a large number of No. 18 copper wires formed into cables about one inch in diameter, known as conductors of 500,000 circular mils. These conductors were extended in each direction from the Albany street power-house entirely through this dangerous district, its longest section being about 4,300 feet. The cables in every manhole within the district, were connected by several No. 12 copper wires to the return conductor and soldered. On first connecting the cables to the return conductor, which took place Dec. 24, 1892, the current was sufficient to melt several strands of No. 12 wire. A measurement for current flowing in the main return conductor which was used for relieving the cables only, gave about 500 amperes.

It may be interesting here, to note comparative voltages in the district near the power-house.

Manhole No.	First Measurement to earth.	After Reversal of Railway Current.	Between Cable and Return Conductor.	Between Cables and Earth after Return Conductor was connected to Cables.
263	1.5+	0.8—	22+	4 5—
264	1 5+	2. +	22+	4.5—
265	0.5+	0 5+	22+	
266	0.5—	2.8+	22+	0.8—
267		4.8+	22+	
268	1. —	5. +	22+	2. —
310	1.5—	3.5+	22+	1.5—
269		4. +	22+	
270		6.5+	22+	
271	2. —	6.5+	22+	1.5—
272		6.5+	22+	0 5—
273		9. +	22+	1. —
274	1.5—	9. +	22+	2.8—
276	0.5+	7. +	22+	2. —
277		2. +	22+	
278	2. +	0.5+	22+	5. —
279		1. —	22+	7.5—
280	3. +	2. —	22+	7.5—
305	1. +	0.8—	22+	3 8—
306	0.5+	0.5+	22+	3.8—
307	0.5+	2.5+	22+	
308	0.5—	4. +	22+	
309	1. —	4. +	22+	3. —
311	1. —	2.5+	22+	
312	2. —	2.5+	22+	
313		3 0+	22+	0.5—
314	1. —	2.5+	22+	2.5 —

The map, Fig. 11, illustrates the condition after the installation of the return conductor at the Albany street station. The red patch which existed in that locality is now removed, and the cables are all negative to earth. The remaining red patches or dangerous sections were corrected by taking similar means of reaching the East Cambridge power house. In treating this latter case, many measurements were made to determine whether or not the railway return wires put up to take the current in a measure from the tracks, would answer for a return for the cables instead of using a special return conductor as had been employed at the Albany street district. It was found that they would not answer, since the potential of these track return wires varied constantly and was frequently above that of the earth.

The cables on the Boston side of the draw of West Boston bridge, proved to be positive to both the rail and the water, while on the other side of the narrow draw, the opposite condition existed, showing at once, that it was unsafe to assume any neutral lines or potential difference, without making measurements to determine the absolute facts.

So far, this paper has delt particularly with the subject of protection of lead-covered cables. It might be inferred that water and gas pipes can be treated in precisely the same manner with the same results, or as water pipes have a much greater sectional area of metal, it might be presumed that simply a connection of such pipes to the dynamo at the power station would be sufficient to bring this potential down to zero throughout the dangerous district. The facts so far coming to our notice would materially modify such inferences, and therefore should find a place here.

That iron pipes are as truly subjected to the corrosion as lead, need not be stated to the members of this society, but for the benefit of city officials and others who may read the paper, it should be plainly stated that they are quite as readily destroyed by electrolysis. Fig. 12 is from a photograph of an iron gas pipe taken from Brooklyn, N. Y.

The City Engineer of Milwaukee, Mr. G. H. Benzenberg, has kindly sent me a photograph of a six-inch iron water main, badly corroded. It is the best specimen of cast-iron pipe I have been able to obtain, although not the most serious case of corrosion. Mr. Benzenberg writes that the trouble in that city was chiefly noticed upon the six-inch water main extending 100 feet on each side of a point opposite the railway power station. Services entering this main were also destroyed, and all were renewed three times during the past two years. He states further, and I quote his own words: "At other points where power houses were established thereafter, the mains were immediately connected by extra heavy copper wires with the generator; we have had no trouble with them so far." Mr. O. H. Tripp, engineer of Rockland, Me., recently furnished me with a specimen of wrought-iron pipe destroyed in five months; the fact is of special interest as it comes from a city having but a small railway system.

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[1] Read before the American Institute of Electrical Engineers, New York, April 18, 1894.

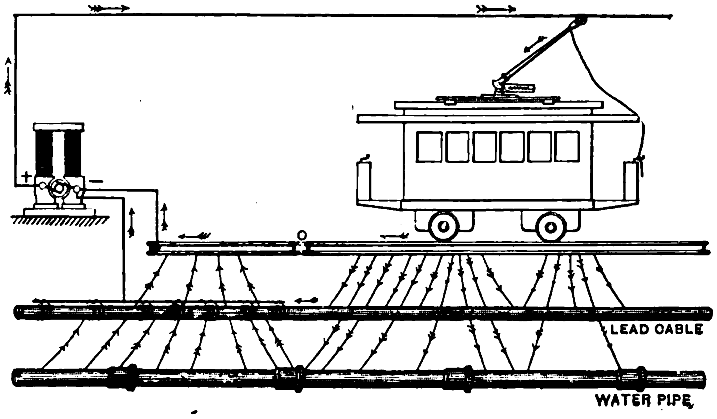


FIG. 10.

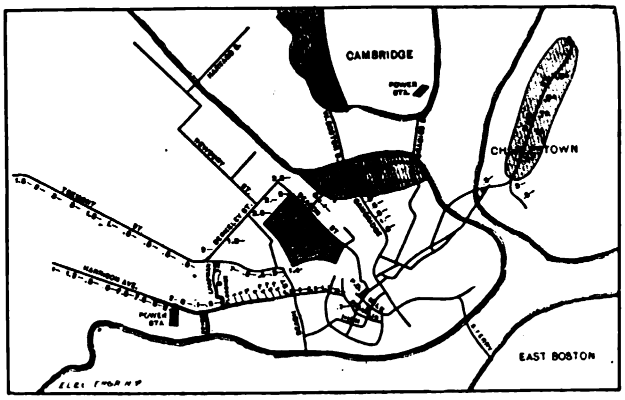


FIG. 11.

In Boston, there have been water as well as gas service pipes corroded through by electrolysis. I have not learned of any mains having burst from this cause. Measurements of water pipes in the city indicate they are still in danger, notwithstanding several thoroughly made connections with the pipes at the power station; the same is true in Cambridge, Mass. This leads me to call attention to an interesting series of inquiries.

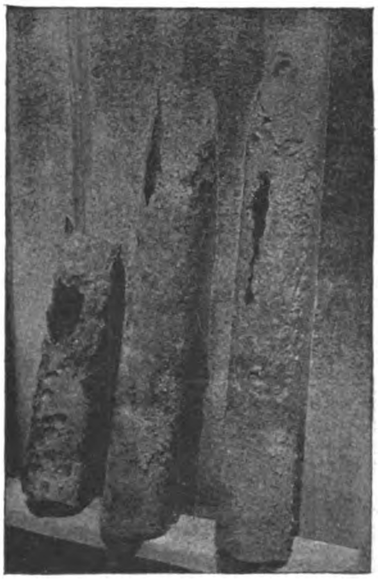


FIG. 12.

The engineer of the Water Board at Rochester, N. Y., suggested to me, a short time ago, while looking into the question of electrolytic action upon the pipes in that city, that possibly there might be sufficient resistance in the joints of the water mains to cause an action upon the lead ring which forms the connection between sections of pipe. He stated that not unfrequently there is found a film of moisture between the pipe and this lead ring, and as the pipes are coated with a preparation of tar or asphalt on both the inner and outer surface before they are laid, there might be a poor electrical connection. Without having made any inquiries or tests upon this point, it seems to me probable that the careful calking which is given these lead rings, would form in some portion of each joint a good electrical connection; that is, one of very low resistance. Recent measurements however made in Boston, and others made in Albany, during the latter part of March, this year, convince me that there is a very appreciable resistance in such joints.

Fig. 13 will illustrate the conditions at Albany. We found the negative side of the dynamo to be connected with the rails, and with ground plates in old wells; no connection had been made with water or other pipes. Directly in front of the power station the voltmeter indicated a pressure of 20 volts between water pipe (an 8 inch cast-iron pipe) and the rail, the pipe being positive. A reading taken about 300 feet in either direction, up or down the street, indicated about 18 volts. At a point 1,200 feet north, the reading was lowered to 12 volts. We then connected the rail side of the dynamo to the street hydrant and took new readings, finding 1 volt at the station, 7 volts at 300 feet distant, the same south, and 8 volts at a point 1,200 feet north.

These measurements, with similar indications in Boston, show plainly that there is a very appreciable resistance in the water-main joints. At the same time the measurements give fair evidence that the difference of voltage between any two sections of water pipe is very small. The interested parties at Albany have kindly consented to allow any facts or figures obtained there in reference to this subject to be placed in this paper.

A few measurements made through the danger district will be of interest. The station is situated near the southern extremity of the city. The danger district extends north about one mile, and over this portion of the district the following figures were obtained. They were taken at nearly uniform distances of about 500 feet, beginning at the station. (See next page.)

It is proposed at Albany to extend large wires (0000) through the dangerous district, one wire for each system of pipes, connecting the pipes to them at frequent intervals.

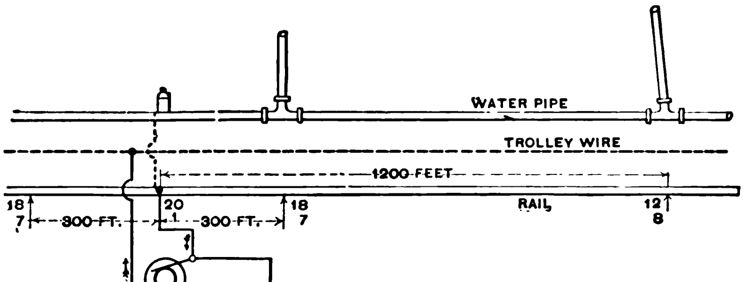


FIG. 13.

It is probable that the remedy which has been applied to telephone cables in some cities, has been the more positive from the very failure, so far, to thoroughly protect the other systems of pipes against electrolytic action. Fig. 13 (shown above) may assist to a clear understanding of this. The cables are here shown connected by a large wire to the dynamo, while water pipes are not so treated. Therefore, the current which enters the water pipes at points outside the danger district passes to the neighborhood of the power station, and, in leaving them there, raises the potential of the earth about the cables. In other words, the current flows from the water pipes to the ground and thence to the cables in order to reach the dynamo.

Connecting any one system of pipes to the dynamo, will, in a measure, protect other systems of pipes, but connecting all systems reduces the certainty or margin of certainty of protection to any one system. This will be apparent from a little study of Figure 10, referred to above.

At Station,	Cable to Earth,	Positive,	12 volts.
" "	" " Rail	"	25 "
" "	Water " "	"	20 "
500 Ft. North,	Cable " Earth	"	10 "
" "	" " Track	"	23 "
" "	Water " "	"	12 "
1,000 "	Cable " Earth	"	6 "
" "	" " Track	"	18 "
" "	Water " "	"	12 "
1,500 "	Cable " Earth	"	6 "
" "	" " Rail	"	18 "
" "	Water " "	"	18 "
2,000 "	Cable " Earth	"	8 "
" "	" " Rail	"	16 "
2,500 "	" " Earth	"	6 "
" "	" " Rail	"	18 "
" "	Water " "	"	8 "
3,000 "	Cable " Earth	"	4 "
" "	" " Rail	"	11 "
3,500 "	" " Earth	"	3 "
" "	" " Rail	"	12 "
" "	Water " "	"	7 "
4,000 "	Cable " Earth	"	3 "
" "	" " Rail	"	8 "
4.500 "	" " Earth	"	1 "
" "	" " Rail	"	1 "
" "	Water " "	Negative	1 "
5,000 "	Cable " Earth	Positive	½ "
" "	" " Rail	"	½ "

When all cables and pipes in the danger district are connected by sufficiently large conductors to drain them, a careful adjustment in resistances in these several conductors may be found necessary in order to insure a balance between the several systems of pipes. It may lead to the necessity of reducing the carrying capacity of the conductor returning to the dynamo from the rails themselves.

The question has already arisen, and it doubtless will be repeated here—"How small a difference of potential between pipe and earth will cause electrolytic action?" In reply to this it may be stated that some of the worst cases of corrosion in Boston, have occurred where the difference was but one and one-half volts. Mr. A. T. Wells, of Chicago, in describing to me an examination of some of the first cases in Cincinnati, states that the "difference of potential between the cables and the rail, was never more than one-half, and usually less than one-quarter volt." Such a difference between cable and rail would mean a much less difference between cable and earth, where electrolysis takes place. Mr. John C. Lee, of Boston, has experimentally caused the corrosion on lead and iron by a difference of potential of $\frac{1}{100}$ volt.

These facts certainly indicate that a very small pressure is necessary to produce the action and should dispel the numerous statements that well bonded rails or a large amount of rail return wires will alone overcome the trouble. In some cities, where electrolysis is in progress to-day, the return copper nearly equals that of the trolley and feed wire system. We cannot force the current to take one path exclusively when others are open to it.

The facts given above, with others similar, though not enumerated, lead me to these conclusions:

1st. All single trolley railways employing the rails as a portion of the circuit, cause electrolytic action and consequent corrosion of pipes in their immediate vicinity, unless special provision is made to prevent it.

2nd. A fraction of a volt difference of potential between pipes and the damp earth surrounding them, is sufficient to induce the action.

3rd. Bonding of rails, or providing a metallic return conductor equal in sectional area and conductivity to the outgoing wires, is insufficient to wholly prevent damage to pipes.

4th. Insulating pipes sufficiently to prevent the trouble is impracticable.

5th. Breaking the metallic continuity of pipes at sufficiently frequent intervals, is impracticable.

6th. It is advisable to connect the positive pole of the dynamo to the trolley lines.

7th. A large conductor extending from the grounded side of the dynamo, entirely through the danger territory and connected at every few hundred feet to such pipes as are in danger, will usually ensure their protection.

8th. It is better to use a separate conductor for each set of pipes to be protected.

9th. Connection only at the power station, to water or gas pipes, will not ensure their safety.

10th. Connection between the pipes and rail, or rail return wires, outside of the danger district, should be carefully avoided.

11th. Frequent voltage measurements between pipes and earth should be obtained, and such changes in return conductors made, as the measurements indicate.

In closing this somewhat rambling paper, I can do no better than use words which will remind you of Patrick Henry: "Eternal vigilance" will be the "price" of pipes and cables where conditions favorable to electrolysis exist.

GENERAL ELECTRIC THREE-PHASE TRANSMISSION PLANT AT TAFTVILLE, CONN.

The first important application of electrical power transmission to textile manufacture has just been installed by the General Electric Company at Taftville, Conn., the power being transmitted from Baltic to Taftville, a distance of nearly four and one half miles. It is a typical transmission by three-phase currents, in which motors of the synchronous type are used not only to operate one of the most interesting cotton mills in this country, but also the power station of the Norwich (Conn.) Street Railway.

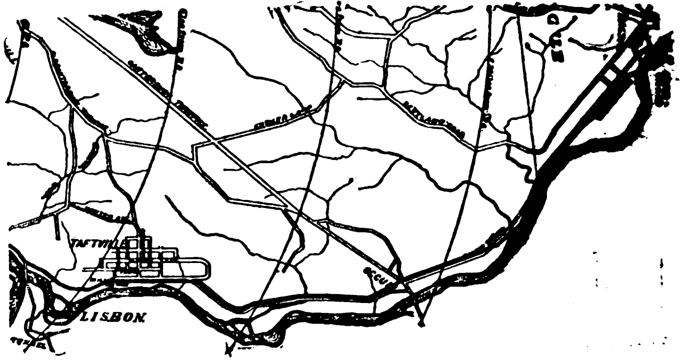


FIG. 1.—ROUTE OF LINE.

Mr. E. P. Taft, the progressive founder of the Taftville cotton industry, long ago recognized the value of the available water power at Baltic, on the Shetugket River, near to which stood a ruined mill destroyed by fire some years ago, and having secured the property with the water rights determined to utilize the power as soon as a successful plan was offered.

The Ponemah Mills are situated at Taftville, also on the Shetugket, and about three miles distant from Norwich. The original mill was operated for a nearly score of years by water power taken directly from the river, and when the new mill was erected it was found necessary to drive it from two 350 h. p. Corliss engines, the existing dam being insufficient in capacity. In these mills are manufactured perhaps the finest and most delicate cotton fabrics produced in this country. All manner of fancy weaves for special purposes, form the regular output of this mill, and the exceptional quality of the goods has kept the plant steadily at work during the dull times, even when cotton mills all over the country have been shut down.

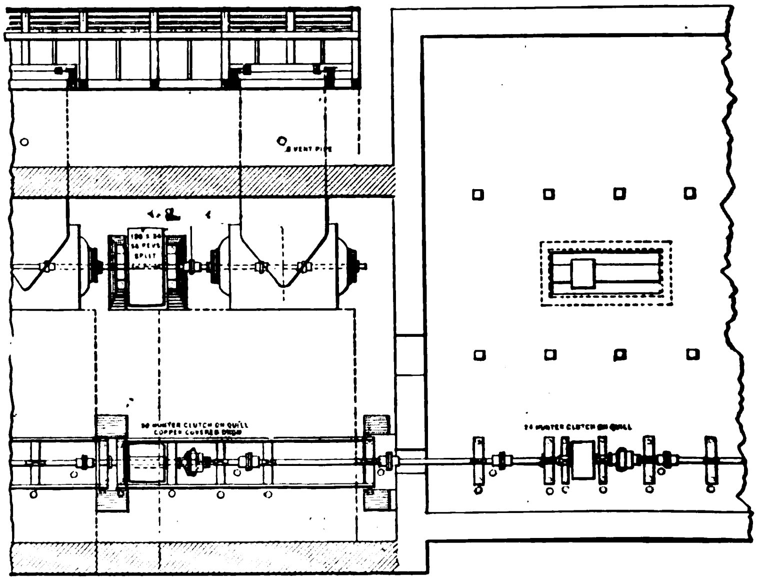


FIG. 3.—PART PLAN, TURBINE AND GENERATOR ROOMS.

In Fig. 1 are shown the relative positions of the generating station at Baltic and the receiving station at Taftville. The line is nearly four and one-half miles in length and is carried along the highway up the river, skirting its bank in places and crossing it at intervals to shorten its route.

The rebuilt mill at Baltic is shown in Fig. 2. In the basement of this building are the wheel and dynamo rooms of the generating plant. The mill is of four stories, built of stone, and will presently be used, as the Ponemah Mills, in the cotton weaving industry. Four hundred feet above the mill a fine stone dam, 525 feet long, has been thrown across the river. The effective head on the turbines is 32 feet, and the water available, even in the dryest seasons, is sufficient to furnish not less than 1,500 h. p.

Fig. 3 is a plan of the basement of the mill in which the power plant is located. It will be seen that the turbines are belted to pulleys on the main line shaft extending the whole length of the wheel room and continuing through the partition walls into and along one side of the generator room. The pulleys are thrown into, or out of, action by Hunter clutches mounted with pulleys on quills, so that any or all of the wheels can be applied to driving the shafts. Similar pulleys and clutches are furnished in the dynamo rooms for throwing in or out the various machines that may there be placed.

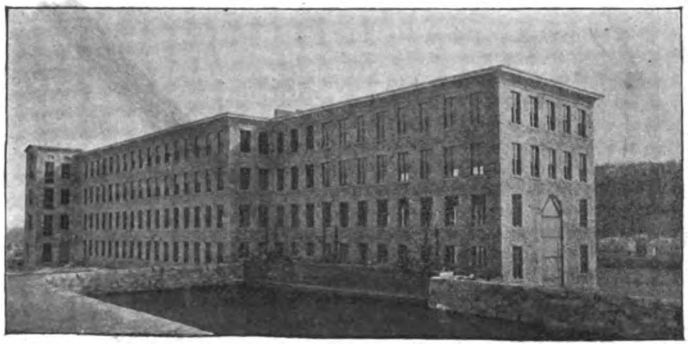


Fig. 2.—Baltic Mill, Showing Reservoir and Intake Gates.

Fig. 4 shows the wheel room and the arrangement of the turbines and line shaft. There are three double 42-inch horizontal wheels and one double 27-inch wheel, the former developing 800 effective horse power each at 157 revolutions per minute, and the latter 300 horse power at 244 revolutions per minute. The belts pass obliquely upward to the pulleys on the line shaft, and the turbines are kept at speed by Schenck electric governors, which have proved themselves capable of doing very fair service. The wheel plant and shafting were made and installed by the P. C. Home Company, of Gardiner, Maine. The line shafting is supported by heavy iron girders set on stone piers and additionally braced by timbers.

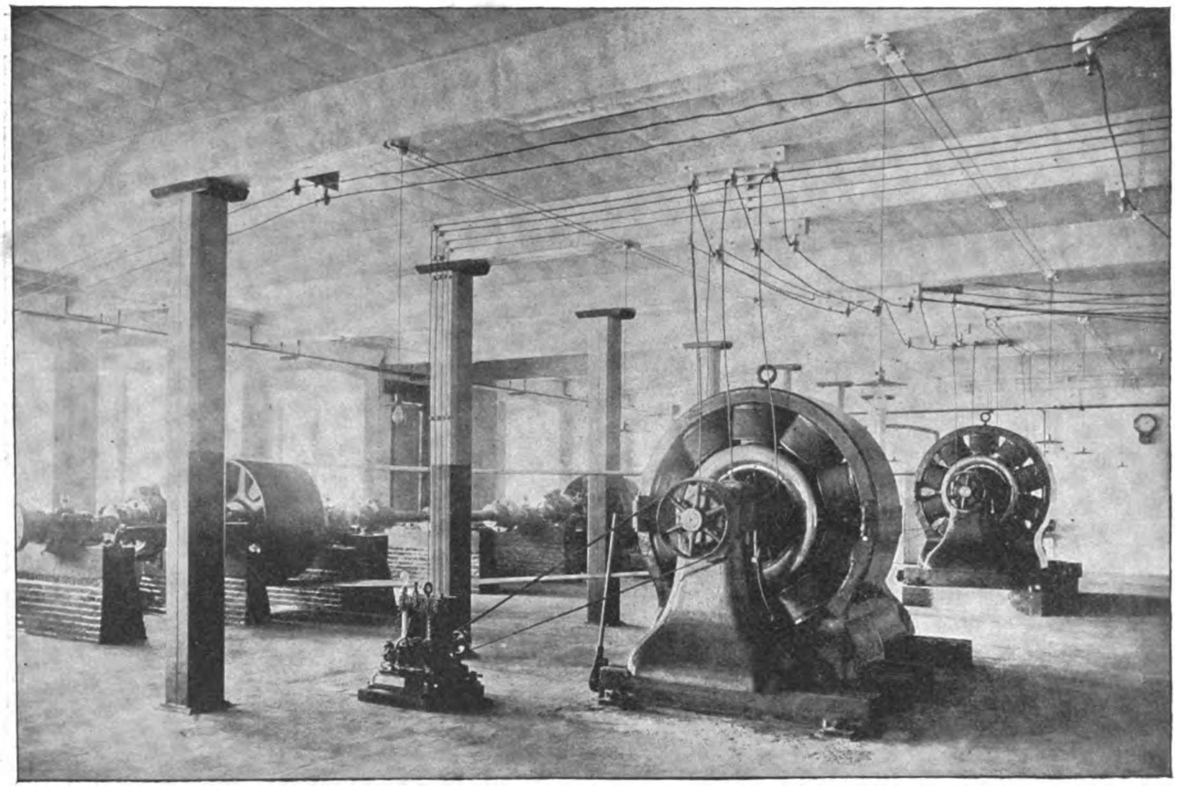


Fig. 5.—Generator Room, Baltic Mill.

The dynamo room, Fig. 5, beside the shafting is occupied by two 250 k. w. General Electric three-phase generators, delivering current on the line at 2,500 volts. Each machine is provided with its own exciter, a 8 k. w. bipolar dynamo. The three-phase machines run at 600 revolutions per minute, and are set so firmly on substantial foundations as to run with scarcely a perceptible vibration. The driving pulleys on the main shaft are fitted with Hunter clutches, so that either machine can be dropped out without the slightest disturbance to the service.

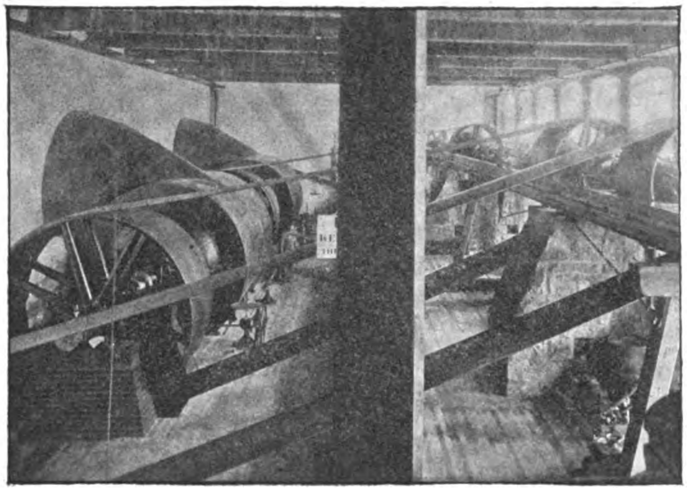


Fig. 4.—Turbine Room.

The generators are connected to a common switchboard, Fig. 6, and may be run in parallel whenever desirable. To this end the board is furnished with synchronizing apparatus, the acoustic synchronizer being mounted on the face of the switchboard, and the equalizing switch being at the back. The most interesting novelties in this switchboard are the high voltage switches on the lower part of the board. These are mounted on marble bases with substantial barriers erected between the switch-blades, so that the circuit at full load and voltage may be broken without the slightest danger of arcing across from point to point. They have been amply tested and have proved their ability to cope with the trying work required of them, with the greatest ease. The generators fall into parallel easily and run as smoothly together as would a couple of railway generators. No artificial load is used in throwing them together, none having proved necessary.

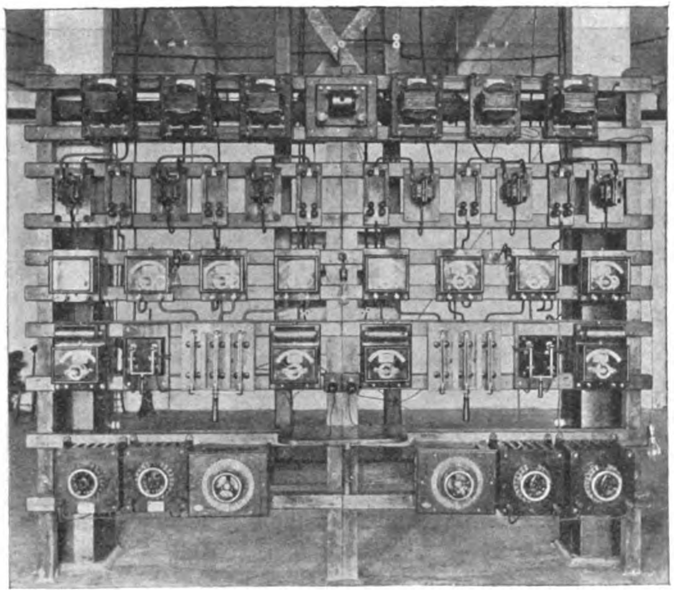


FIG. 6.—SWITCHBOARD IN BALTIC MILL.

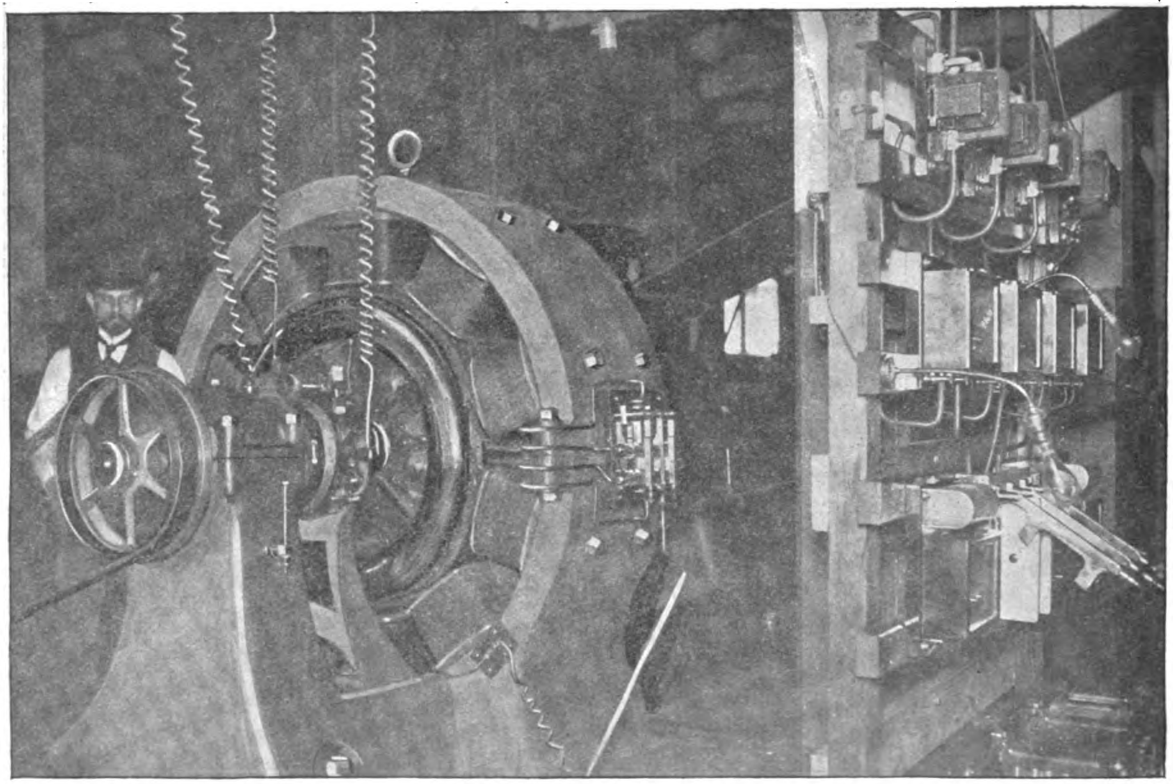


FIG. 8.—SYNCHRONOUS MOTOR, BASEMENT PONEMAH MILLS.

The line, a characteristic bit of which is shown in Fig. 7, is a good piece of construction work on substantial wooden poles placed 100 feet apart. The wires on the upper cross arm are of No. 0 bare copper and form the original three-phase circuit designed for the transmission. The wires on the lower cross arm are No. 0000 insulated wire, and are four in number. They were originally intended for a railway circuit, the generators for which were to be installed at Baltic to feed the Norwich Street Railway, but as the amount of copper necessary to do the work successfully appeared too great, the system was changed, a second three-phase generator and motor were added, and three of the four proposed feeder wires were utilized for the three-phase circuit. All are supported on the General Electric Company's standard oil insulators, the fourth No. 0000 wire forming a convenient relay in case of accident to any of the others.

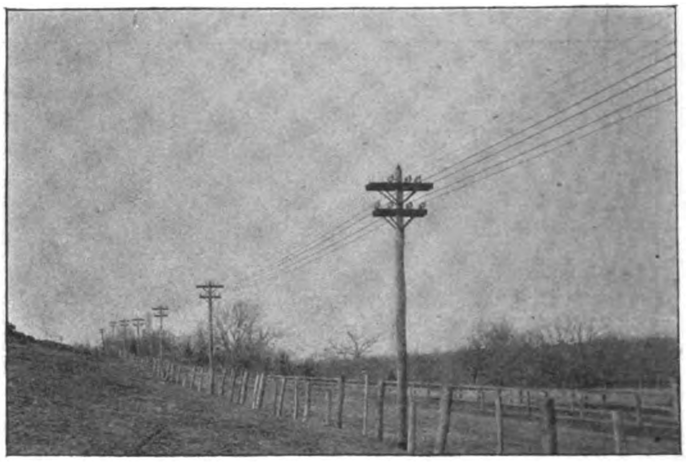


FIG. 7.—THE LINE.

At Taftville the three-phase circuits are led into the basement of the new mill, where they drive two three-phase synchronous self-starting motors, identical in size with the generators at Baltic. These machines replace the two Corliss engines previously used. One motor, with its switchboard, is shown in Fig. 8, which also gives an excellent view of the high voltage switch before referred to. These motors are belted to the jack shafting previously driven by the engine, the pulleys on the shaft being equipped with friction clutches so that the load can be thrown from engine to motor, or back again, without any interruption of service.

The motors start entirely unaided, coming up to synchronous speed in about fifty seconds from the time the current is thrown on. They are, like the generators, separately excited, the exciters being driven from the pulleys on the end of the motor shaft.

The efficiency of the complete transmission at full load from the power applied to the dynamo pulley to that delivered to the motor pulley is just 80 per cent. In originally starting the mill before the second motor was ready for operation, it was the custom to bring the motor up to speed, and then gradually throw in the clutch connecting it to the shafting already running from one of the engines. When the clutch was fully in and engine and motor running together, the engine was disconnected by its clutch and the power transferred entirely to the motor. This could be done without producing the slightest disturbance in the speed, and in the same way, now that both motors are in and the engines shut down, the load can be shifted from one motor to the other if desirable. Ordinarily, however, there is work enough for both, when driving the 1,700 looms in the new mill, operating the lighting plant and the three 80 h. p. General Electric railway generators, installed in another part of the basement.

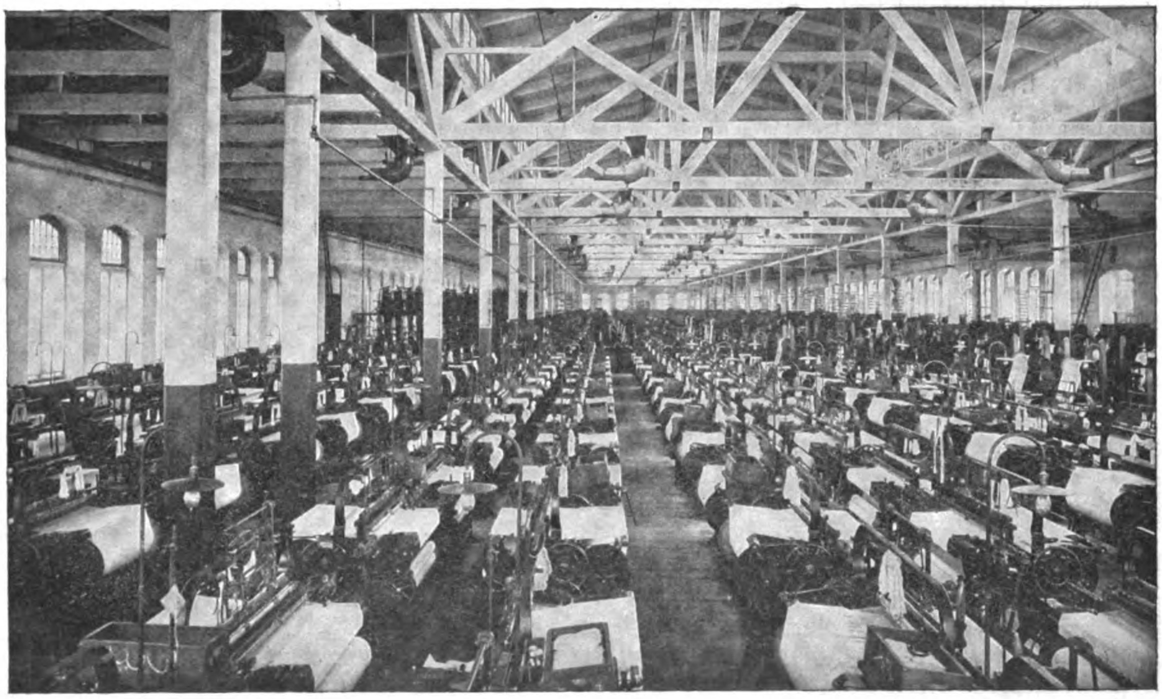


FIG. 9.—UPPER WEAVE ROOM, PONEMAH MILLS.

Fig. 9 shows the upper weave room of the new mill driven by these motors, and gives some idea of the work done by the motors and the extensive operations of the mill. This weave room is occupied at present in the production of delicate plain cotton goods for printing, the Jacquard looms for fancy goods being located on the floor below.

The first motor was started more than two month ago, and the complete plant, entirely installed by the Power and Mining Department of the General Electric Company, has now been in operation for several weeks, entirely displacing the steam service, and performing its duties in a highly satisfactory manner. It is already attracting great attention among cotton manufacturers, and Mr. Taft, whose farsighted enterprise has put through this most important application of electrical power, is in constant receipt of letters of inquiry regarding its operation, which he is able to answer in the most encouraging terms.

A NOVEL MUNICIPAL PLANT SCHEME FOR ATLANTA, GA.

A proposition has been made by the Standard Electric Company, of Chicago, to the Mayor of the City of Atlanta, Ga., to furnish the City of Atlanta with a municipal plant. The city is now paying the local electric light company $100 per year per arc light, which is a low rate as compared with the price paid in many other cities in the United States. The proposition of the Standard Electric Company is that they are to receive pay for their plant by accepting each year the difference between the cost of producing the light from their plant and the price now paid for the light. In other words, they guarantee and pledge that the lights shall not cost the city over $42.00 per year each, leaving the difference between that figure and the present cost of light, that is, $58.00 per light, to go towards payment for the plant, which they estimate will take five years and two months to wipe out, and the city would then own the plant free of debt. The electric company are now furnishing four hundred and twelve arc lights of two thousand candle power each, and five hundred and fifty eight series incandescent lights of seventy-five candle power each. The city's intention is to substitute arc lights for the incandescents.

THE LAWRENCE ELECTRIC RAILWAY CONDUIT.

AT the works of the Harlan and Hollingworth Company, in Wilmington, Del., there is at present in operation a conduit system that appears to offer a good solution of the underground trolley problem. It bases its claims on simplicity, reliability and low cost of construction, approaching closely the overhead trolley in all these respects.

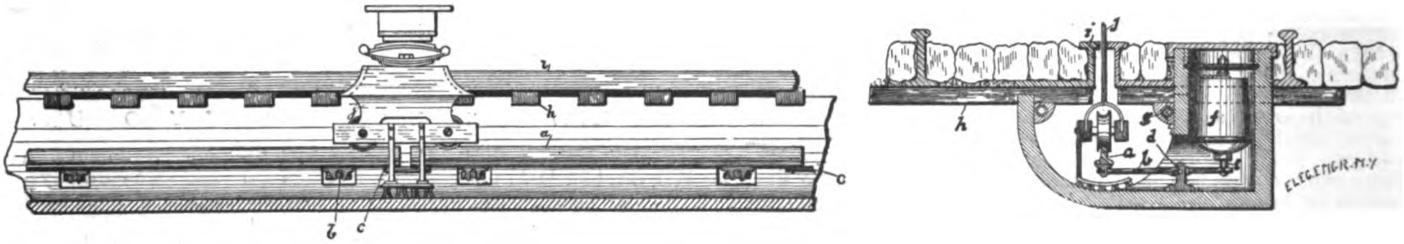
This conduit as now constructed is shown in the accompanying diagrams. It consists of an inverted T-shaped girder rail *a*, resting on two balanced contact arms *b*. These girder rails are 82 feet long, and joined together at their extremities by means of pieces of hard vulcanized fibre boards *c* screwed to the under side, leaving an insulating air space between the rails. The contact arms are balanced on a spindle at *d* and are connected to a rod *e* that enters the box *f* through a flexible bottom. A branch of the feed wire *g* enters the top of the box and makes electrical contact with the rod *e* when the latter is raised by the weight of the trolley at the other end of the arm *b*. The current then goes through *b* and *a* to the trolley wheel.

The conduit proper is made of vitrified clay, moulded in the form of an elliptic cylinder, and cut lengthwise, forming two lengths from each casting. These are placed end to end. The ties are laid directly on the conduit and project over as far as the slot and act as a support for the cover. For the cover a girder *i* of L-shaped section is placed over the ties and then the roadway is paved with stone or concrete.

The collector *j* is a compound affair, that is, it has two wheels, one placed about six inches forward of the other, and electrically inter-connected. This is to prevent any break in the circuit in going from one section to another, thus preventing arcing in the boxes.

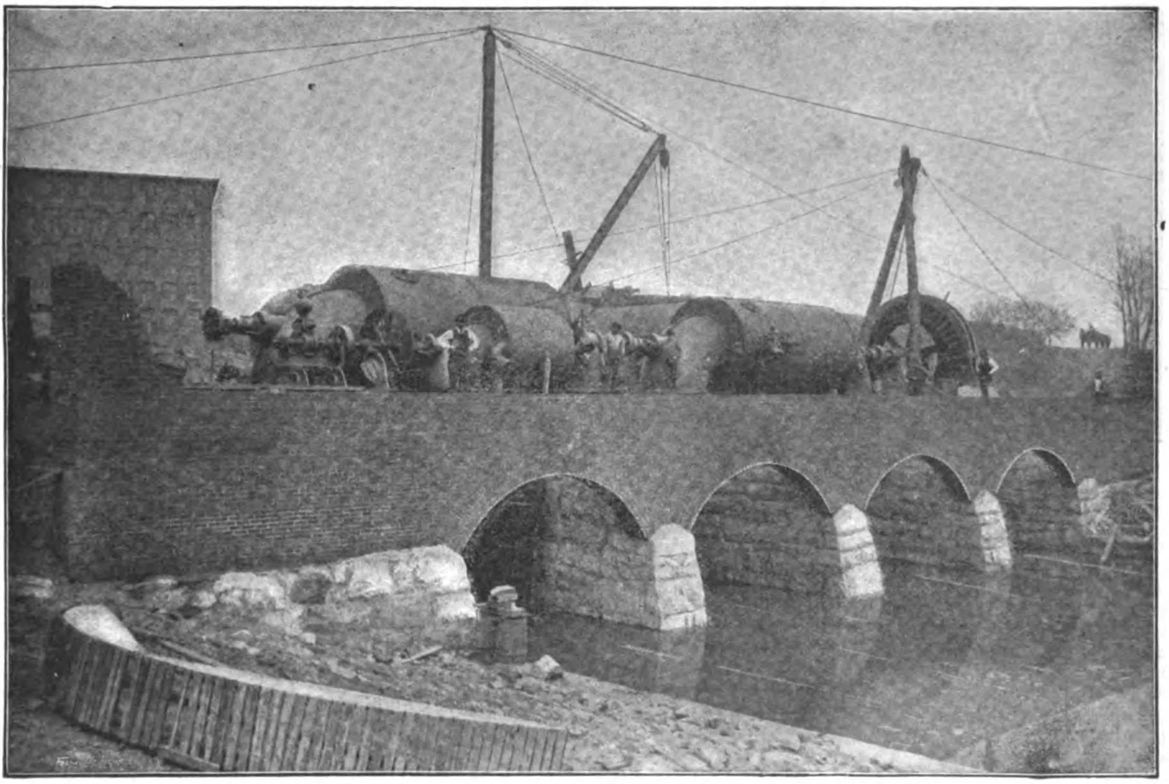
The system has been in operation since March 14th and it is claimed that it has worked perfectly from the first. During the recent great storm the track was covered to a depth of three feet with salt water. The car had been left near the top of a grade so at that point the water was only up to the lower part of the motors. The electrician *rowed* out to the car and, getting on, threw on the switch, running the car back and forth as far as the depth of the water would allow, without flooding the motors.

The car is one of the regular summer cars used in Wilmington; it weighs nine tons and has been run up and down the track, loaded, at a speed of twelve miles per hour. The limited length of the track precludes trying it at a higher rate, but there appears to be no reason why it should not be successful at much higher speed. The trolley runs equally well backward or forward without making changes, and it is impossible for it to leave the girder rail; consequently there is no danger of losing control of the car for lack of current at critical periods. With a double track the boxes are placed between the tracks, one box acting for both tracks but being so constructed as to make electrical connection to one track only, unless there be a car on each track; then, of course, it would make connection to both.



THE LAWRENCE ELECTRIC RAILWAY CONDUIT—LONGITUDINAL AND TRANSVERSE SECTION.

In the office of the Lawrence Electric Company, No. 18 Astor place this city, there is a small working model of the system. There a car runs around the room and the track is so arranged as to show the operation of the different sections. An electric lamp held to the section upon which the trolley rests immediately flashes out a full light. This dies out the moment the car passes to another section. All the rest of the road is "dead" except that immediately before and behind the car.



THREE-PHASE TRANSMISSION PLANT AT COLUMBIA, S. C.

Mr. George E. Hicks, of Hicks Bros., 59 Wall street, is the president of the company.

THE DELAWARE, LACKAWANNA & WESTERN RAILROAD CO., have placed the order for two engine house roofs with the Berlin Iron Bridge Co., of East Berlin, Conn. Both roofs will be covered with the Berlin patent anti-condensation corrugated iron.

OPENING OF THE ELECTRIC RAILWAY FROM JERSEY CITY TO NEWARK.

The electric road between Newark and Jersey City was formally opened on April 21. Three cars, crowded with prominent men of New York, Jersey City, Elizabeth, and Newark, made the trip from the Court House to the Jersey City Ferry in fifty minutes and then the passengers participated in a lunch at Taylor's Hotel before making the return trip. The cars ran smoothly, and the trip was made in excellent time.

A THREE-PHASE TRANSMISSION PLANT AT COLUMBIA, S. C.

We are enabled by the courtesy of the Stilwell-Bierce & Smith-Vaile Co. to illustrate the power plant of the Columbia Cotton Mills, Columbia, S. C.

The power plant consists of two pairs of 48 inch cylinder gate Victor turbines on horizontal shaft with a single 24 inch horizontal Victor turbine for driving the fire pump. The two pairs of 48 inch turbines are connected together and at each end are direct connected to a generator of 700 h. p. capacity, the electrical plant being installed by the General Electric Co. This is the first instance in the South where an entire cotton mill will be driven by electricity. The entire power plant was designed and furnished by the Stilwell-Bierce & Smith-Vaile Co. of Dayton, Ohio, in connection with the plans for the mill which were furnished by Lockwood, Green & Co. of Boston, Mass. The cut shows the Victor wheels in position with direct connection to dynamos.

MR. W. H. BRENNER has resigned his position of electrical engineer of the Montreal Street Railway Co.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED APRIL 24, 1894.

Alarms and Signals:—

Fire Alarm Box, W. H. Kirnan, Bayonne, N. J., 518,722. Filed Jan. 31, 1894.

Conductors, Conduits and Insulators:—

Cleat for Supporting Conducting Wires for Electric Circuits, H. B. Wyman, Slingerlands, N. Y., 518,907. Filed Dec. 20, 1893.

Distribution:—

Apparatus for Neutralizing the Effects of Self Induction in Alternating Current Circuits, J. F. Kelly & C. C. Chesney, Pittsfield, Mass., 518,738. Filed Nov. 13, 1893.

Employs a transformer having its primary in derivation to an alternating working circuit possessing self-induction, and a condenser in the circuit of its secondary; the transformer and condenser being so proportioned as to produce in the current in the primary of the transformer a negative lag for neutralizing the effects of self-induction in the working circuit.

Means for Reducing the Apparent Energy Supplied to Alternating Current Magnets, J. F. Kelly, Pittsfield, Mass., 518,739. Filed Nov. 18, 1893.

Claim: As a means of reducing the current required for energizing an electromagnet by an alternating current, the combination with said electromagnet and in inductive relation to its primary or energizing coil of a secondary coil and a condenser in the circuit of said coil and a capacity less than that required for neutralizing the self-induction of said secondary for a given frequency.

Dynamos and Motors:—

Alternating Current Dynamo, J. F. Kelly, Pittsfield, Mass., 518,740. Filed Dec. 22, 1893.

Employs an armature comprising polar projections with induced coils and a yoke bridging the projections; the reluctance of the yoke being high relatively to that of the projection.

Armature for Dynamo Electric Machines or Electric Motors, T. H. Hicks, Detroit, Mich., 518,756. Filed Jan. 9, 1893.

Relates to certain mechanical details of construction.

Dynamo Electric Machine or Motor, A. L. Riker, New York, 518,768. Filed Jan. 29, 1894.

A dynamo or motor so constructed that some of its integral parts, while retaining their ordinary functions, also act as a casing to protect the working parts, etc., from water, gas or dust.

Automatic Device for Removing Resistance in Starting Electric Motors and Replacing Same, G. H. Whittingham, Baltimore, Md., 518,906. Filed Apl. 4, 1893.

Commutator Brush, C. W. Brown, Deering, Me., 518,918. Filed Nov. 15, 1893.

Claim 1 follows:

A commutator brush composed of woven wire cloth folded together and the inner layers only of which are impregnated with a graphite compound left in a soft yielding condition and adapted to make contact at its end with the commutator.

Lamps and Appurtenances:—

Electric Arc Lamp, R. Segardahl, Chicago, Ill., 518,654. Filed Sept. 29, 1893.

Relates to certain construction in constant potential arc lamps having reference especially to a feed mechanism maintaining an arc of practically uniform resistance.

Support for Electric Light, W. H. Connell, Wilmington, Del., 518,713. Filed Mch. 28, 1893.

Relates to methods for supporting incandescent lamps in convenient positions upon desks, etc.

Electric Arc Lamp, C. Hoffman, Berlin, Germany, 518,719. Filed Sept. 28, 1893.

Relates especially to cut-out mechanism for arc lamps in parallel whereby one or more lamps, having become inoperative, may be cut-out without affecting the remainder of the circuit.

Duplex Arc Lamp, C. E. Scribner, Chicago, Ill., 518,792. Filed Dec. 10, 1890. Has for its object to enable the lamps to be burned in groups of two so arranged that one will burn after the other.

Miscellaneous:—

Electrical Calculating System, H. Hollerith, Washington, D. C., 518,604. Filed Dec. 9, 1892.

Relates to the Hollerith census tabulating system (See "Counting a Nation by Electricity," THE ELECTRICAL ENGINEER, Nov. 11, 1891.)

Protector for Electric or Other Bells. L. R. Lecellier, Villedieu, France, 518,618. Filed July 31, 1893.

Electric Lock, J. Eldon, Lock Haven, Pa., 518,667. Filed Oct. 31, 1892.

Method of and Apparatus for Electro-chemical Decomposition, H. Carmicheal, Malden, Mass., 518,710. Filed Jan. 23, 1892.

Producing Metallic Zinc, P. C. Choate, New York, 518,711. Filed Dec. 9, 1891.

Art of Producing Metallic Zinc, P. C. Choate, New York, 518,732. Filed Jan. 21, 1892.

Diaphragm for Electrolytic Cells, E. A. Le Sueur, Ottawa, Can., 518,786. Filed Aug. 29, 1892.

Electric Instrument Table, J. E. Mehren, Chicago, Ill., 518,788. Filed Feb. 7, 1893.

Lightning Rod and Coupling, J. W. Smith, Galesburg, Ill., 518,793. Filed Jan. 6, 1893.

Electric Releasing Device for Doors, S. H. Curwen, Salem, Mass., 518,877. Filed July 12, 1893.

Tabulating System, H. Hollerith, Washington, D. C., 518,885. Filed Aug. 1, 1893.

See No, 518,604 (Miscellaneous).

Tabulating System, H. Hollerith, Washington, D. C., 518,886. Filed Nov. 17, 1893.

See No. 518,604.

Electric Belt, P. E. Petterson, Minneapolis, Minn., 518,894. Filed July 26, 1892.

Railways and Appliances:—

Electrical Device for Towing Vehicles, T. P. Milligan, South Orange, N. J., 518,673. Filed June 3, 1892.

Relates especially to the towing of canal boats by means of a fixed overhead rail and a motor running thereon.

Controlling Switch for Electric Railways, P. Lange, Newark, N. J., and B. G. Lamme, Pittsburgh, Pa., 518,693. Filed Feb. 25, 1893.

Employs a method of control which consists in connecting the motors in series, establishing a shunt around one of them, decreasing the resistance in the shunt until the motor is short circuited, cutting out the motor and finally putting all the motors in multiple with each other.

Conduit Electric Railway, C. A. Maynard, Springfield, Mass., 518,695. Filed Feb. 9, 1894.

Relates especially to certain mechanical details in the construction of a conduit trolley and conducting rail.

Electric Operating Mechanism for Vehicles, L. E. Freedley, Boston, Mass., 518,781. Filed Dec. 29, 1893.

Relates to methods of quickly transferring the current from the driving motors of electric cars to supplemental motors operating the brakes.

Distribution System for Electric Railways, J. E. Goodhead, Baltimore, Md., 518,782. Filed Jan. 20, 1894.

A sectional conduit railway in which the successive sections of conductor are energized by being brought into connection with the feed wires by the pressure of the trolley.

Switches and Cut-Outs:—

Electric Switch, E. Woltmann, Chicago, Ill., 518,800. Filed July 11, 1893.

A push button snap switch for incandescent lamps.

Electric Switch, W. S. Hill, Hyde Park, Mass., 518,818. Filed Oct. 31, 1893.

Relates to special construction of jack knife switches and has for its object to increase the carrying capacity and to improve the fit of the contact parts.

Telephones and Apparatus:—

Telephony, W. C. Lockwood, New York, 518,742. Filed June 27, 1892.

Claim 1 follows:

An electrode for telephone transmitters consisting of chloride of silver.

Telephone System, U. H. Balsley, Philadelphia, Pa, 518,773. Filed April 29, 1889.

Relates to the switch plugs and their contacts and to means for so supporting the plugs as to avoid confusion and the tangling of their flexible cords.

Telephone Transmitter, H. Cottrell, Newark, N. J., 518,916. Filed March 15, 1894.

Claim 1 follows:

In a telephone transmitter, a variable resistance piece consisting of a conducting base having projections extending therefrom, a diaphragm susceptible of being vibrated by sound waves, and means for varying the contact between the projections, in correspondence with the vibrations of the diaphragm, to produce variations in the current.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW YORK NOTES.

J. F. ROGERS & Co., of New York City have placed the order for a new Industrial School building at Havana, Cuba, with The Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 15 metres wide and 48 metres long, constructed entirely of iron and cement.

THE PLANTÉ Co., 27 Pine street, Robert McA. Lloyd, president, has been formed to make, sell and install storage batteries. It is licensed under the patents of the Accumulator Co. (including the Faure patent and others) and under the Brush patents. It will also supply, when called for, the most improved type of the pioneer Planté cell. The company has issued a circular giving sizes of its cells, prices, etc.

MR. E. V. BAILLARD, manufacturer of electrical instruments and machinery, has opened a shop on his own account, at 106 Liberty street; where he will produce the same high grade of work as was turned out of the factory of the Equitable Mfg. and Electric Co., of which he was superintendent. His specialty will be experimental work and any of his electrical friends wishing an invention intelligently developed will do well to call on him.

THE INDIA RUBBER AND GUTTA PERCHA Co., of 315 Madison avenue, New York and Glenwood, Yonkers, has issued a very neat, simple and effective price list and catalogue of its celebrated wires and cables, used for all manner of purposes under the sun, earth and water, as well as in tube or plaster. Nearly twenty separate heads of manufacture are enumerated and reference is made easy by means of annotation in the outer margins of the pages. Mr. W. M. Habirshaw, the general manager, has copyrighted the catalogue which contains a great variety of useful data and information as to the material itself that is used—pure rubber—and as to the forms of insulation into which it is very carefully worked up. The list of consumers shows that the Habirshaw products are appreciated in a good many discriminating quarters.

NEW ENGLAND NOTES.

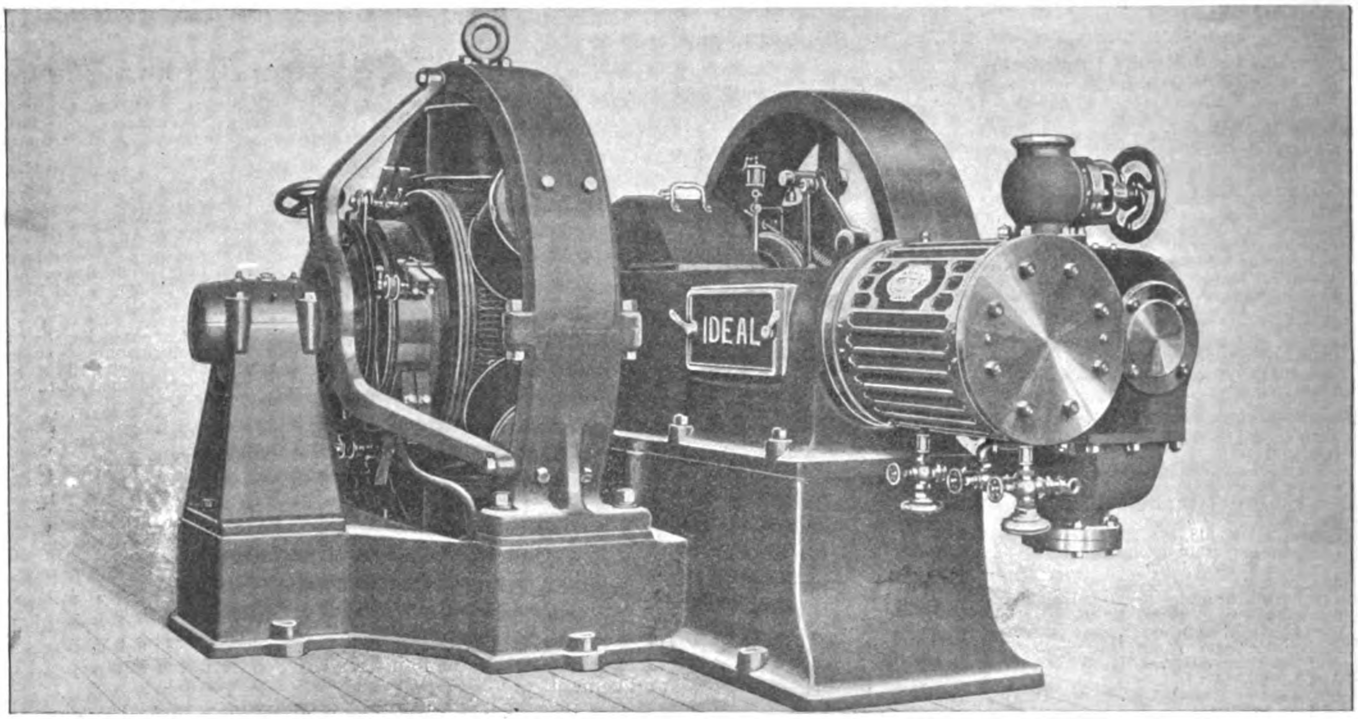
G. M. ANGIER & Co. report a good demand for their "Three Good Things," among central stations and construction companies.

THE CALUMET & HECLA MINING Co., have placed the order for a new iron building with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 40 feet wide and 125 feet long, covered on the roof and sides with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron. The iron work for the extension to the E. W. Bliss & Co., foundry building at Brooklyn, N. Y. will also be furnished by The Berlin Iron Bridge Co.

THE HART & HEGEMAN MANUFACTURING Co., of Hartford, Conn., have now got comfortably settled down in their new quarters on High street, and are well forward with their work which had run somewhat behind owing to the delay occasioned by removing. The new factory has about five times as much floor space as their old premises, and with their increased facilities they should do a very much larger business than ever before. Business continues good with them and the Hart switch appears to keep easily in the front ranks as a favorite, judging from the large orders coming in almost every day.

DIRECT-CONNECTED HARRISBURG IDEAL ENGINE AND GENERAL ELECTRIC GENERATOR.

We illustrate herewith a direct connected steam electric combination of the latest type. The engine is the "Harrisburg Ideal" self-oiling pattern, cylinder 12″ diameter by 12″ stroke, manufactured by the Harrisburg Foundry and Machine Works, Harrisburg, Penna. The dynamo is the product of the General Electric Company, 50 K. W. capacity, speed 275 r. p. m. 450 amperes, 110 volts, and of the multipolar type.


Direct-Connected Harrisburg Ideal Engine and General Electric Generator.

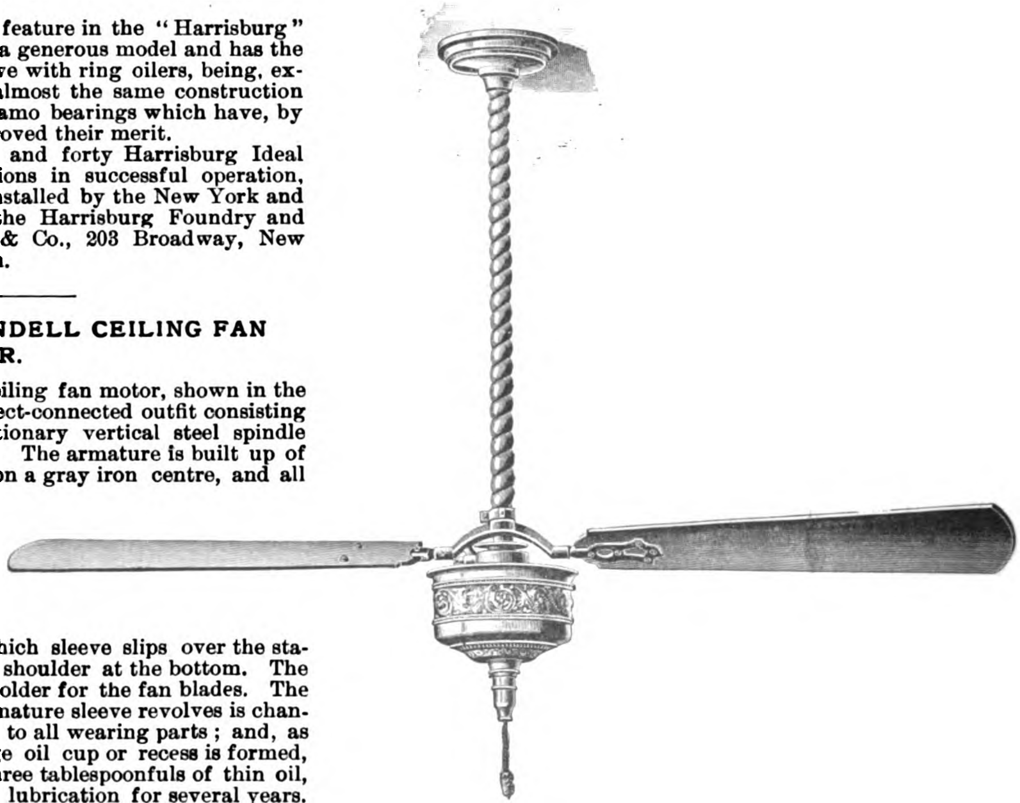
The self-oiling out-board bearing feature in the "Harrisburg" Ideal Engine shown, is designed on a generous model and has the latest arrangement of movable sleeve with ring oilers, being, except for increased weight and size, almost the same construction as the standard Edison bi-polar dynamo bearings which have, by years of universally good service, proved their merit.

There are now between thirty and forty Harrisburg Ideal electric direct-connected combinations in successful operation, nearly every one of which were installed by the New York and New England representatives of the Harrisburg Foundry and Machine Works, W. R. Fleming & Co., 203 Broadway, New York, and 620 Atlantic Ave., Boston.

DIRECT-CONNECTED LUNDELL CEILING FAN MOTOR.

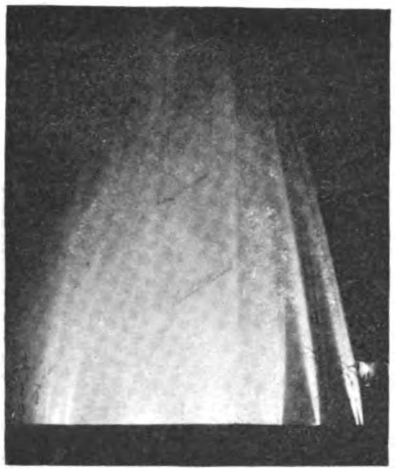
The 1894 model of the Lundell ceiling fan motor, shown in the accompanying illustration, is a direct-connected outfit consisting of a four-pole field carrying a stationary vertical steel spindle attached firmly to an under spider. The armature is built up of the usual laminations of soft iron on a gray iron centre, and all carried on a composition sleeve, which sleeve slips over the stationary spindle and rests upon a shoulder at the bottom. The armature sleeve also carries the holder for the fan blades. The stationary spindle on which the armature sleeve revolves is channeled out for the free passage of oil to all wearing parts; and, as a part of the bottom spider, a large oil cup or recess is formed, which, when properly filled with three tablespoonfuls of thin oil, will, it is claimed, insure perfect lubrication for several years. The oil is introduced to the motor at the upper end of the composition sleeve which carries the armature.

The upper end of the stationary spindle is threaded. The lower end of the gas pipe hanger rod is threaded inside and out, and is slotted longitudinally for a short distance on one side. When the motor spindle is screwed into the hanger pipe, a clamp, which is furnished with the outfit, is placed tightly in position in order to prevent unscrewing. The direction of rotation of the fans tends to screw the spindle further into the hanger. All motors are connected up in the factory before shipment. A very simple device is employed for attaching the motor to the ceiling. It is a flexible insulated connection, and its use will be apparent on inspection. Over the hanger pipe is placed an ornamental piece of brass rope tubing. Lead wires from the motor are furnished, of sufficient length to pass up through the hanger pipe to the outlet at the top over the canopy. A single pull switch is attached to the bottom spider of the motor. This switch is shipped ready wired up and properly attached.


Direct-Connected Lundell Ceiling Fan Motor.

THE
Electrical Engineer.
Vol. XVII. MAY 9, 1894. No. 318.

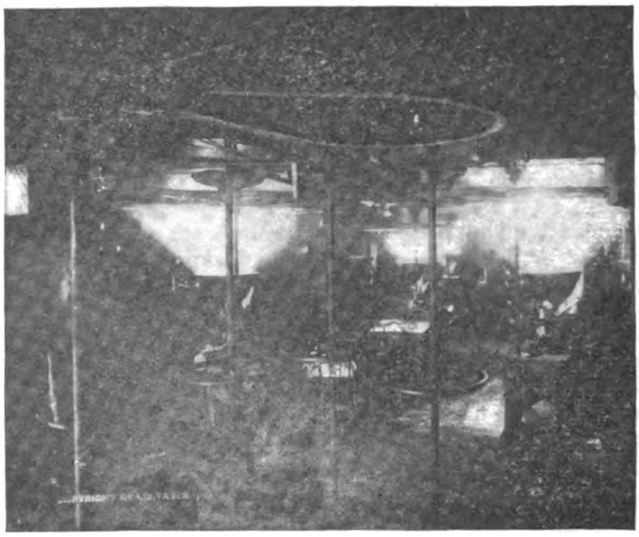
ELECTRIC LIGHTING EFFECTS AT THE MIDWINTER FAIR.



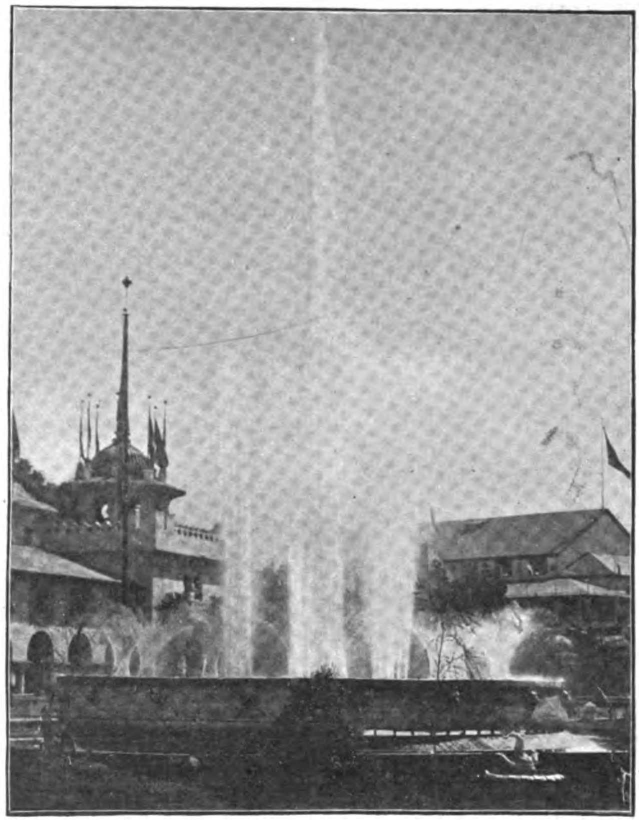
Fountain in Full Play.

THE articles that have appeared in THE ELECTRICAL ENGINEER already in regard to the Midwinter Fair, have acquainted its readers with the many features of that interesting display, in which, as usual, no small part of the work to be done in drawing a crowd has devolved upon electricity in one or other of its applications. The special correspondence appearing in this issue gives further information on the subject, while we are glad to present here some very interesting night views of the Fair from photographs by Taber.

Coming so soon after the great Chicago Columbian Fair, it is not to be expected that the Midwinter can show us much that is new or novel, but it is evident that some of the lessons from the earlier attempt have been applied in the latter. This is more particularly true in regard to the night effects and to their systematic reproduction by the photographic art. It is a notorious fact that at the World's Fair, the official photographer, Arnold, missed his opportunity by failing to preserve the night aspects, and that such pictures as we have are due almost wholly to private and amateur effort. It will be remembered that at the recent convention of the National Electric Light Association at Washington, an evening was spent in running over a series of night views, a remarkable feature about which was that scarcely any of them were due to the official photographer but came from artistic and observant amateurs, or from those whose profession it is to study lighting effects. As will be seen, however, Mr. Taber has lost no time in getting night views, for sale, etc. A number of other private pictures are now in the possession of Mr. Luther Stieringer, as the result of his recent trip to San Francisco and of his special suggestions and study of the scene. These pictures supplement the series obtained through many years by Mr. Stieringer, who has insisted on the necessity of studying such scenes by their own light, and who therefore can show some striking examples in gas, oil, etc., as well as those taken by electric light at the Fair last year.



INSIDE THE FOUNTAIN CAISSON: SHOWING METHOD OF THROWING LIGHT UPWARD.
(*Copyright by Taber, San Francisco.*)



THE ELECTRIC FOUNTAIN BY DAYLIGHT.
(*Copyright by Taber, San Francisco.*)

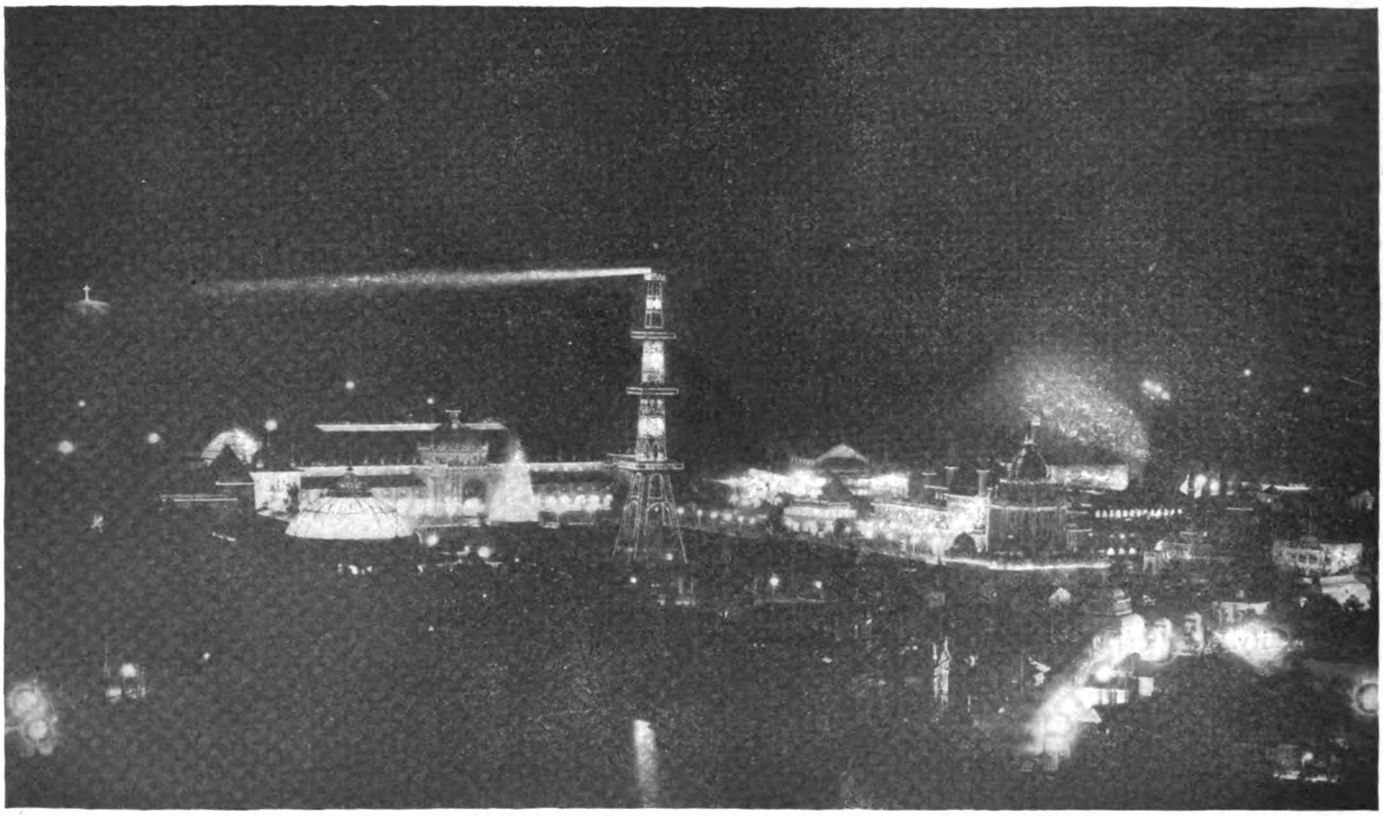
Details are given in our special correspondence as to the Tower of Light, and the "search" that surmounts it. This light is of 200 amperes capacity and was shown at the World's Fair by the General Electric Co. mounted on the Colonnade, at the South East end of the Grand Canal. Our illustration gives an admirable idea of the effect produced by its use, especially when its beam is thrown upon the cross at the summit of Lone Mountain. The cornice lighting of the buildings as shown in this picture is done by the General Electric Co. and the lighting of the grounds is due to the Fort Wayne Electric Co.

In the electric fountain, we have another familiar object, it being one of the two celebrated Stieringer fountains which were so great an attraction every night at the Chicago Fair. The setting is, of course, somewhat different, as will be noted from the day and night views, but the modus operandi is the same, and the brilliant results are the same, though, if anything enhanced by the better working. We show in vignette one of the "full play" effects, and illustrate also the interior of the fountain as set up in the Midwinter grounds. Readers who are specially interested in the subject of electric fountains will find a six-page description of the Stieringer, with fourteen illustrations, in THE ELECTRICAL ENGINEER of May 3, 1893, in which article all the various operations are described and depicted in minutest detail.

The view shown of the interior of the fountain as operated at the Midwinter is especially interesting as regards the large mass of it going up straight through the color screen and plate glass window.

As the water is in constant flow, without regular outline from one moment to another, the refinement afforded by the lenses is not at all needed, or even noticeable. Moreover, where the light is projected the intensity is increased with corresponding advantage in spectacular display.

One of the marked improvements in the operation of the fountain at the Midwinter is obtained by throwing a search beam in colors on the higher streams when in full play. It is to be regretted that an attempt made to secure this effect at Chicago, where the situation was more favorable, was not carried out. The contrast of colors and lights is wonderfully vivid and beautiful. The search light has also been put to ingenious use in this practically new art of night photography, and the result is that, as our first picture shows, all the detail can be brought up. While the negative is exposed, the search beam is continuously swept over the scene, and thus the darkness is washed out by the growing flood of light, until at last the object is stamped on the negative with an almost daylight clearness. Some of the building photographs at the Midwinter, brought out in this manner by Mr. Joseph Mullender, the clever operator for Mr. Taber, are as bold and strong as though taken under a high sun. The photographs by Taber, sent us by our special correspondent, are certainly among the finest specimens of such work that have ever come under our notice.



NIGHT PHOTOGRAPH OF THE MIDWINTER FAIR, WITH SEARCH BEAM TURNED ON LONE MOUNTAIN.

(Copyright, by Taber, San Francisco, 1894.)

the means of concentrating light within the holophote. The means here adopted have proved singularly effective and economical. Sir F. Bolton in his first fountain in England used what is commonly known as a range light, built up out of a series of fine lenses at a cost of about $1,500 or $1,600 per orifice. When the first fountain was built shortly after, in this country, at Staten Island, this item of expense was considered extravagant, and experiments were made at the Brush station in New York with the ordinary locomotive headlight reflector. The results obtained were quite satisfactory and so much so that the Galloway fountains at the Paris Exposition were built on the same plan, which, in spite of its American origin, became known as the English method in contradistinction to the French method of using two mirrors. The official report described it as superior. It originated, however, beyond all question at Staten Island, and now prevails. The picture given here affords an excellent demonstration of the direction given to the light by the reflector, little being lost at the edges and

It is to be hoped that this work of night photography may be followed up, in various ways, as it cannot but be productive of instruction. Prof. E. S. Holden, of the Lick Observatory, mentions the fact that work which took him four years at Washington, in the study of the nebula of Orion, was done again, and better, at the Lick Observatory, in forty minutes, by means of photography. There is an immense significance in such a statement.

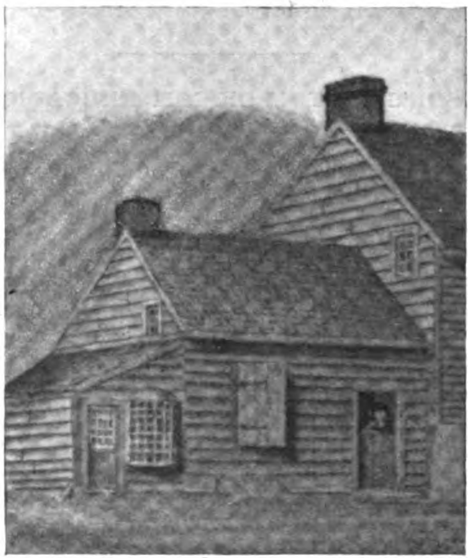
THE ELECTRO-MAGNET; or JOSEPH HENRY'S PLACE IN THE HISTORY OF THE ELECTRO-MAGNETIC TELEGRAPH.—XII.

(Concluded.)

BY

Mary A. Henry

OUR story of Henry's magnets is completed; that is, of the construction of them. Each century will furnish a new chapter in the history of their use. "Big Ben" stands in one of the halls of Princeton College, and there too is the sensitive *intensity* magnet, which gave to the world the telegraph, and the *quantity* magnet which led to the great discovery of magneto-electricity; all honored relics. The busy brain which conceived them, the hands which formed them, are no more; but they wake to life under the influence of the electric current as readily as when Henry made them.



SOUTH PEARL STREET, ALBANY, WHERE HENRY WAS BORN.

(From an old water color drawing).

The magnets in the world of to-day are only these, Henry's children grown larger; more pounds of iron in the core, more wire in the coil; this is all, there is no other difference. They are Henry's children still, obeying always the law of construction and the law of the relative electric flow and resistance which he discovered for them. Henry bent the iron of the magnets into the form of a horseshoe for the purposes of convenience, the instruments are now often used in the form of a spool; everything is the same as in the other form except that the bar is straight: one of Henry's earliest magnets was made with a straight bar. All over the world, wherever there is any application of electro-magnetism, are these same spool or horseshoe magnets: in the physical laboratory, in the observatory where electricity records the observations of the astronomer, in the manufactory, in the home where the sewing machine turns its busy wheel. The philosopher, the artisan, who uses them, may have forgotten or never have known their origin; nevertheless the indispensable servants of mankind everywhere in the civilized world are these electromagnets made first by Henry in 1829 and 1830.

"Come with us now into the telegraph office and let us see what we find there;" again we quote from Mr. Dickerson, "if the line be a short one—say thirty or forty miles—you will see but one of Henry's spools fixed to a table, having a piece of iron called an 'armature,' capable of vibrating in front of its poles, and so arranged that when the 'spool magnet' attracts it, it will vibrate and strike a sounding bar of sonorous metal, which gives out distinctly the sound of the tap. The 'spool' is wound spirally in layers with several hundred feet of fine copper wire, covered with silk, in the manner specified by Henry in 'Silliman's Journal.' At the other end of the line is a battery, composed of a number of cells in series, called by Henry for distinction an 'intensity battery;' and the wire circuit is supplied with a simple device, so that it may be opened or closed by the operator's finger. When he closes it, a current of electricity flows from the 'intensity battery' along the wire, and around the coil of the 'intensity magnet,' and the armature strikes the sounder and gives the signal. The listener hears it; and as the order of the taps progresses in accordance with a pre-arranged artificial code, to express the letters of the alphabet by combinations of successive taps—just as the old visible signals were arranged by combinations of the successive movements of the vanes, or afterwards of the needle of the Gauss and Weber telegraph—he hears letter after letter tapped out and the message is understood.

"*Now that apparatus has nothing about it more than was in Henry's Albany telegraph of* 1831[1]; *nor could it operate if it omitted any one of the inventions, either singly or together, which were then for the first time combined. It depends entirely upon the discoveries made by Henry before* 1831; *and it could not have existed in the world earlier than those discoveries, by the use of any means then known to man; nor since by any other means than those discovered by Henry.*

"Henry used a bell as a sounder; they now use a metal bar and a sounding box. Henry reversed the battery current, whereby no spring is needed to withdraw the armature for the purpose of vibrating it; and that is the common practice in English and German telegraphs. Here they generally merely interrupt the circuit, and the armature is withdrawn from the magnet by a spring, although Henry's device is also used here largely, and is essential to the quadruplex instruments.

"If, however, the telegraph line is a long one—it may be a thousand miles or more—then you will see two sets of Henry's spools, and two batteries. One is the 'intensity battery and spool' first described; and the coil of fine wire may be, and often is, several thousand feet long—while the battery is composed of more than a hundred cells. The distance being so great, they do not attempt to send force enough through the intensity circuit to operate a sounder, but only to open and close the local circuit of Henry's quantity battery and spool. That circuit consists of a battery of but one or two cells of large surface, and a spool with about a hundred feet of coarse wire wound around its core. The intensity combination opens and closes this quantity circuit, whose armature strikes the sounder, just as the intensity armature itself does on shorter lines. *This obvious plan Henry described and exhibited in Princeton to his classes, long before any magnetic telegraph was ever commercially constructed.*

"Upon that apparatus there are four names to be written. Oersted, who discovered the effect of the voltaic current upon the magnetic needle; Arago, who discovered that the voltaic current could generate magnetism; Sturgeon, who produced the first electro-magnet; and Henry, who discovered the conditions under which an electro-magnet might be operated at a distance—who invented the devices by which it could so operate—and who applied those devices to an operative telegraph, of the same form and substance as that now in use all over the world. Beyond their discoveries and inventions nothing is essential to the present telegraph, except that which was of common knowledge when those discoveries were completed, and that ordinary mechanical skill which is far below the level either of discovery or invention."

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[1] Mr. Dickerson has not given quite an early enough date for the Albany telegraph. It was in existence as early as 1830.

Oersted, Arago, Sturgeon: honored be their names, but we have seen that in their hands the telegraph was an impossibility. They planted their mile stones on the road towards it, but did not reach this goal. Again I would ask the reader to consider what constitutes the telegraph. It is that magic circuit in which the electro-magnet, indifferent to distance, responds to the influence of the galvanic battery. Whoever gave this circuit to the world is the father of the telegraph. Look at it; the magnet is Henry's. Mr. Taylor says, "Let it never be forgotten that he who first exalted the quantity magnet of Sturgeon * * * was the absolute creator of the intensity magnet: that magnet which alone 'is able to act at a great distance from its exciting battery'—that magnet which 'is alone applicable to the uses of the telegraph.'" But not only is the sensitive magnet with its subtle power Henry's gift; the law which tells what kind of battery must be its coadjutor is Henry's by discovery. He gave the magnet, he brought the magnet and battery into harmonious accord. This circuit is Henry's.

The important device of bringing into play one circuit by means of another, this too is Henry's. What remained then to be discovered in regard to the telegraph after Henry left it? Nothing. The electromotive force secured, the well-known mechanical appliances for the use of force, might be employed in various ways. Very clear, I would repeat, should be the distinction between the telegraph itself—that is the means of obtaining electromotive power at a distance—and methods of receiving and recording the message, or in other ways using the power. These clever contrivances may in every country be different, and may change every year; they may be very ingenious but they do not constitute the telegraph; strike out Henry's magic circuit, and they are useless bits of wood and metal. The dots and lines and the printed forms which first appealed to the eye, have long been superseded by intermittent sounds which address the ear. In fact even Henry's mechanical method of employing the electrical force now prevails.

"Let us now consider" (I quote again from Mr. Dickerson) "what would have been the position of Henry in the world, if at any time before his inventions had been so long in public use that he had lost his rights, he had taken a patent for :—

First, his magnetic spools pure and simple;

Secondly, the combination of a magnetic spool of long fine wire, with an "intensity battery" for the purpose of producing a practical magnetic effect at great distances;

Thirdly, the combination with such an apparatus of a quantity battery, operating upon a spool magnet of coarse and short wire, at a distance from the intensity battery; whereby the great lifting power of the quantity magnet might be controlled by the intensity combination;

"And *finally*, the combination of the intensity battery and spool, with a vibrating armature, so arranged as to strike a sounder when the circuit is closed or opened at the sending end, for the purpose of transmitting intelligible messages, telegraphically.

"All these he might have patented in the United States at any time during several years after his discoveries and inventions were made; and he could have held them against the world. That he was the first man to do these things is not in doubt any where. If he had taken such a patent, as late as 1837, he would have controlled the telegraph in this country, certainly until 1851; and unless he had then been adequately rewarded for his great inventions, his term would have been extended till 1858.

"Imagine the good he would have done to science had the wealth which this would have produced been poured into his purse! But listen to his noble words: 'At the time of making my original experiments in electro-magnetism in Albany, I was urged by a friend to take out a patent, both for its application to machinery, and to the telegraph; but this I declined on the ground that I did not then consider it compatible with the dignity of science to confine the benefits which might be derived from it to the exclusive use of any individual.'

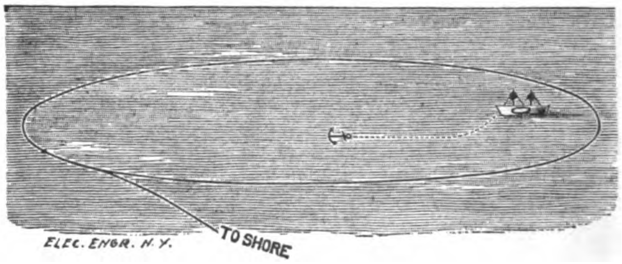
"Pure science was his beloved, and he could not make merchandise of *her*.

"When that sentence was written, other eminent scientists had thought differently of this question, and had patented their discoveries; and lest he might seem to cast a reproach upon them, and to say 'I am holier than thou;' his humble spirit added these words: 'In this *perhaps* I was too fastidious.'

"It must have occurred to him at times when he needed money for his experiments, and when he saw the fruits of his labor enriching the world, that he might have taken some share of the wealth; but he would not taint with selfishness his generous gift."

STEVENSON'S SYSTEM OF COMMUNICATION WITH LIGHTSHIPS.

MENTION has already been made in these columns of the method devised by Mr. Charles A. Stevenson for effecting constant electric communication between lightships and the shore. This method is based upon the simple induction between wire and wire and is illustrated in the accompanying engraving appearing in the London *Electrical Review*.

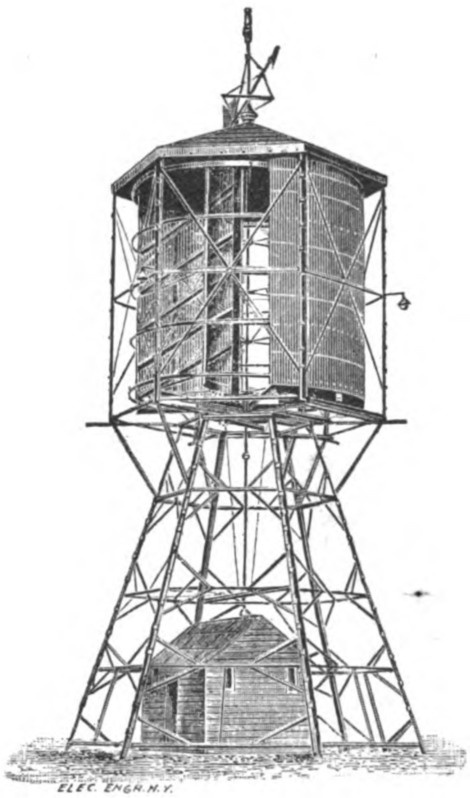


STEVENSON'S SYSTEM OF COMMUNICATION WITH LIGHTSHIPS.

A cable is laid from the shore out to the vessel, where it makes one or more turns round the area over which it is possible for the lightship to travel, which is, of course, governed by the length of her chain cable. On board the ship there is an insulated coil of a number of turns of thick copper wire and entirely insulated from the sea. On each of these two circuits there are the batteries and telephones. Now, it is evident that the two coils, that on board the ship and that on the bottom of the sea, must generally be close to each other, say, within 100 yards, and the coils, moreover, must always be in a strong magnetic field with respect to each other, as the one is always inside, so that very little battery power will be requisite. Mr. Stevenson has already made coils work at 600 yards *outside* each other with only eight turns on each coil, and five cells as a battery power, the coils being about 200 yards diameter, so that it is evident that but a very feeble battery power will be necessary with the increase in the number of turns on board the lightship, and from the fact that they lie inside one another in place of outside.

THE ROLLASON WIND MOTOR FOR ELECTRIC LIGHTING.

An exhibition was given at Willesden Junction, near London, recently, of an electric generating plant operated in connection with a novel type of windmill known as the Rollason wind motor. From the illustration, for which we are indebted to the London *Electrical Engineer*, it will be noticed that it is a horizontal arrangement contained in a skeleton turret. From the top to bottom of the centre or axis of the turret is provided a vertical steel shaft; this has attached to it five concave sails, which revolve on radius rollers immersed in oil. On these sails are fixed a number of inclined ridges or planes, which it is claimed deflect the force exerted by the wind to their peripheries. Between the sails and the shaft is arranged a considerable open space which allows the wind to actuate simultaneously three sails out of the five. Outside the sails is a framing, or screen, supported by six radial or cross arms, which are bolted to a centre bearing, which is free to rotate independently of the sails. A second vertical shaft from the top of the shield is continued through the roof of the turret, and to this is fixed a vane, so that when the direction of the wind changes, it moves the shield into the correct position for only the concave sides of the sails to catch the wind. On the top of the sail shaft is fixed a cup containing a quantity of oil, within which are rollers, by which the shaft actuates the shield. The weight of the vane shaft is carried on an independent roller bearing fixed in the roof of the turret. The whole weight of the sails and framing carrying the shield is thrown to the centre bearings on the bottom of the turret, which thus gives to the working parts of the motor the desired balance.


ELEC. ENGR. N.Y.

THE ROLLASON WIND MOTOR FOR ELECTRIC LIGHTING.

The motor is 20 ft. in diameter, and is erected on an open iron structure 30 ft. high. The power developed by the motor is transmitted by a vertical shaft running down the centre of the supporting framing into a wooden shed on the ground. Suitable gearing is provided on the lower end of the shaft for working the pulleys actuating by belting an Elwell-Parker dynamo, which is used to charge accumulators.

The electric details which permit of the batteries being charged under variable speed of the dynamo are withheld from publication.

ELECTROSTATIC INDUCTION MACHINE WITHOUT SECTORS.[1]

Since bringing out his first electrostatic machine, in 1883, Mr. Wimshurst has made a number of improvements on it. The Wimshurst machine, as is well known, consists of a disc of insulating material provided with sectors radially arranged, but a simplification of the machine, which is claimed also to increase its output, has been recently made by M. Bonetti. This has been effected by doing away entirely with the metallic sectors and increasing the number of the rubbing brushes. This is the practical realization of a suggestion made by M. George Pellissier, in 1891, in the *Journal de Physique.*

The disc machine constructed according to this plan is shown in Fig. 1. This has all the elements of the Wimshurst machine minus the metallic sectors, but having a greater number of brush holders which allow the brushes to slide upon the diametrical conductors. The discs may be either of glass or hard rubber. The machine is not self-exciting, the excitation being produced by rubbing one of the plates with the finger covered with amalgam; but once accomplished the direction of current does not change. Reversal of the current during action is only produced by rubbing the other plate at a symmetrical point. This constancy of direction of the current and the ease with which it can be rapidly and surely reversed constitutes one of its special advantages in electro-therapeutics.

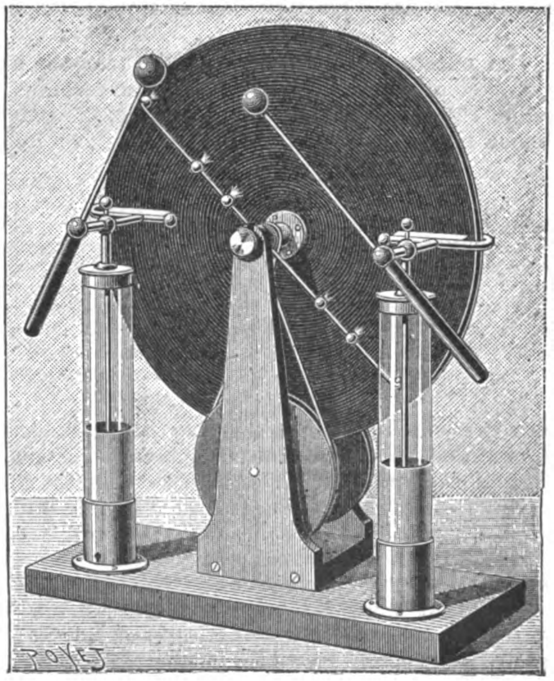


FIG. 1.—BONETTI-WIMSHURST MACHINE WITHOUT SECTORS.

The output can also be varied within wide limits, either by reducing the number of contact brushes or in displacing their points of contact on the disc. When the whole surface of the disc is brushed by metallic points the output is a maximum. As measured by the Lane electrometer, the output according to M. d'Arsonval, is three times as great as that of a Wimshurst machine of the same dimensions provided with sectors. In displacing the brushes so that they touch the same zone the output is reduced in proportion to the surface brushed.

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[1] *La Nature.*

The principle of the Wimshurst machines without sectors has been also applied to a more powerful machine, shown in Fig. 2, in which the discs are replaced by two concentric cylinders of hard rubber, the mean diameter of which is 50 centimetres and height 50 centimetres. The two cylinders, separated by only a few millimetres are mounted on two thick ebonite discs fixed on concentric spindles with ball bearings and driven by a friction gear. A series of combs and external and internal brushes take the place of the radial combs and brushes of the disc machine. The engraving, Fig. 2, shows the machine as exhibited before the French Physical Society.

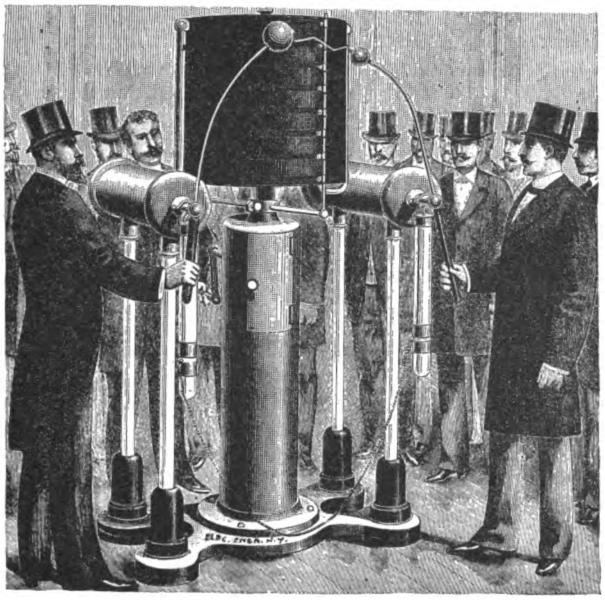

FIG. 2.—THE BONETTI-WIMSHURST MACHINE WITHOUT SECTORS.

"UNKNOWN" CAUSES OF FIRES.

BY

H. C. Cushing Jr.

EVERY fire which takes place in any city of considerable size is recorded as to location, loss, amount of insurance carried, and the cause, or supposed cause, of the fire. In the city of Boston there were, during the year 1893, 1,233 fires, with a loss of $5,024,765.04. Twenty per cent. of all these fires are from unknown causes. When these unknown causes cost property owners more than $1,004,955 it is about time that some investigations were made beyond attributing these causes to spontaneous combustion, incandescent or arc light wires, or to any other wires which enter a building. When an inspector cannot satisfy himself that it was from the stoves, careless use of kerosene or matches, it is a very easy thing to lay it to spontaneous combustion or the unfortunate electric light wires.

The person attributing fires to the electric light wires being crossed with some trolley or other high potential wire outside is probably not aware that every wire entering a building is thoroughly protected at its entrance by a fusible metal which will blow out at any overcharge, thus deadening every wire in the building; and, moreover, there would have to be a decided ground within the building, which is nowadays a very rare occurrence, as the writer's investigations have proved that out of twenty-five prominent buildings in the city of Boston the insulation resistance to ground proved to average over 2,000,000 ohms. But when I say that the electric light and power wiring should not receive the blame as often as it does, I do not mean to take the responsibility off electricity, for it is through this agent that I have reason to suspect the origin of many of the "unknown" causes, so-called, on fire reports.

When electricity is allowed to roam at large and in vast quantities all along our water and gas pipes and through the ground upon which the city is built, in order to get back to the sources at which it was generated, which are the street railway power stations, it is this state of affairs which is creating a trouble, the extent and seriousness of which is only known to those few who have made it a study. These street railway power stations, operating the overhead trolley system, are constantly generating thousands of electrical horse power, sending it out by overhead trolley and feed wires to the cars which it operates, and returning it to the station by means of the water and gas pipes which lie in its course. For this reason there is a tremendous electrolytic action going on all the time. The writer has samples of gas and water pipe completely eaten through by electrolytic action in three months after having been placed in the ground near street railway returns.

Wherever this returning current flows in any quantity along a pipe there is bound to be a large fall of potential, varying in different pipes as their carrying capacity increases or diminishes. In the cellars and basements of many houses I have found quite a large difference of electrical pressure between two pipes entering within one foot of each other; and in one instance it was a very easy matter to take a piece of hoop iron and draw an electric arc sufficient to ignite a piece of waste held near it; and by connecting these pipes together with a piece of No. 18 copper wire the current flowing through it was sufficient to heat it so that it was impossible to lay one's hand upon it. In the basement of another building within the city limits, I find a man using twenty-five amperes at eight volts pressure, or electricity enough to run small motors and incandescent lamps, as well as all the electrical bells in the entire building, by simply twisting his wires around two different water pipes which enter the building. Some time ago my attention was called to two pipes which were so close together that the vibration of an elevator engine caused them to knock together just sufficient to create an arc every time a contact was made and broken. This had been going on so that it had almost completely eaten through the gas pipe, and it is perfectly evident what would have taken place had this been allowed to go on unobserved. The gas would have been ignited by the electric spark as soon as the first small hole appeared, and disastrous results would have undoubtedly followed.

This difference of electrical pressure between water and gas pipes is now so well known that in a number of cases in the cities of Boston and Cambridge the ordinary electric bell battery is entirely discarded, and the wires from the bells connected directly to water pipes, the latter furnishing an inexhaustible supply of electricity at the proper pressure to run any number of bells or gas lighting apparatus, and also to do any quantity of mischief. I can see no reason why fires should not be attributed to this cause, when it can be proved that such a difference of electrical pressure really does exist between any two pipes entering a building in the vicinity of the trolley system of street railways.

There is only one way of eliminating this rapidly increasing danger, and that is by compelling the electric street railway companies to insulate from the ground their entire electrical circuit, and just as soon as a suit for damages is brought by the water and gas companies for systems of pipes destroyed by electrolysis, the railway companies will begin to remedy the evil, which they are more fully aware of than anyone else.

ELECTRICITY AT THE MIDWINTER FAIR AT SAN FRANCISCO, CAL.

(From A Special Correspondent).

"What would the Midwinter be without electricity!" a prominent Californian was heard to exclaim, and that is the thought, if not the expression, of all who visit the "Sunset City." The marvelous lighting effects produced on the Bonet Tower and in the electric fountain, the flashing of the great search light and the fairyland enchantment of the evening illuminations, taken as a whole, these are the things that people go to see, and talk about after they have gone.

The principal Buildings, five in number, are situated on the four sides of the Grand Court. The architecture of the Palace of Mechanical Arts, Liberal Arts, and Administration Buildings is oriental in character, while the Fine Arts Building speaks of the Nile; and the old Californian Mission appears in the Palace of Agriculture and Horticulture. All of these structures are outlined with incandescent lamps and as the Golden Gate gradually closes after the retreating form of Old Sol, streams of light begin to run here, there, everywhere, carving out of the dusk one beautiful palace after another and finally out of the centre of the Court a mass of fire climbs up into the heavens and the Bonet Tower stands, all dazzling with red, white and blue light.[1]

The Tower is 265 feet in height, with a base 48 feet square, a graceful structure of latticed ironwork. An elevator runs up through its centre, carrying passengers, first to a landing 90 feet up, where the inner man can be refreshed, and then still higher to a platform, 200 feet above the ground, where the eye is feasted on a grand view of San Francisco's hills, thickly covered with residences, and then beyond, to the magnificent Bay, and out to the Pacific, while just below and around lies Golden Gate Park and the Sunset City.

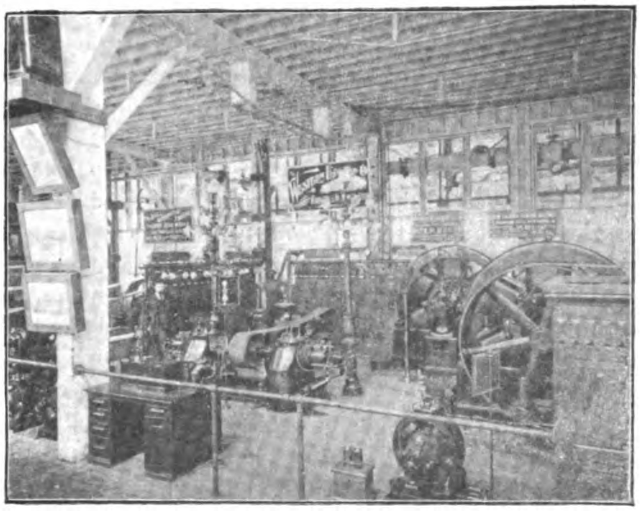

EXHIBIT OF THE WESTERN ELECTRIC CO.

Every truss and brace in the tower is thickly studded with 16 c. p. incandescent lamps, to the total number of 3,218. Twelve hundred of these lamps are arranged into variable designs, which appear and disappear, increase and diminish, as if by magic. These lamps are controlled by a large rotary switch operating on the principle of the barrel in a music box, one hundred sets of cams or projections, on its surface, actuating a like number of bell cranks, at whose outer ends are clamped carbon points. As these points are lowered and raised the various circuits are closed and opened, an air jet at each contact, blowing out any damaging spark. The barrel is revolved at a regular rate by a small electric motor, while a second motor runs a small air blower. Any combination of circuits may be obtained, as the projections can be easily removed and placed in any desired relation with each other. The designs at present in operation were selected by Lieut. Hasson, Chief of Electrical Department, from twelve sets submitted by Mr. Jenness of the Western Electric Co. The number of lamps employed in these twelve sets varied all the way from five to forty thousand and that in use is a combination selected out of the lot. On the platform at the very top of the Tower, is placed the largest search light in the world, built by the General Electric Co., throwing a beam of light which is roughly estimated to be of 350,000,000 candle power. The tower was designed by Mr. Bourgeois, architect, of Chicago, and was erected by the Pacific Rolling Mills of San Francisco.

The tower incandescent system was installed by the Western Electric Co., of Chicago, who are represented on the coast by Mr. E. W. Goldschmidt. The exhibit of this company in the Palace of Mechanical Arts, which is in charge of Mr. C. D. Wilkinson, is worthy of note. It consists of two 150 K. W., 220 volt, 6-pole generators and two 30 K. W. generators, the latter operated by a 60 K. W. 500 volt motor. These not only furnish current for the tower, but also for the electric theatre and for the power circuit throughout the grounds. Four 50-light arc machines, of the well-known pattern of this company, furnish arc lights for the Manufactures and Liberal Arts Building. Numerous "ring type" motors, from 2 to 15 h. p., are operated from the power circuit. Two large marble switchboards are also exhibited by this company, each having a capacity of 1,200 amperes at 250 volts and 800 arc lights.

At the east end of the court is one of the large Stieringer electric fountains which added so much to the World's Fair illuminations. This is operated by the General Electric Co., who have a large and varied display of apparatus in Mechanical Arts Building. A complete three-phase power transmission plant is shown in actual operation, the power being furnished by a bi-polar motor, which is belted to a 35 K. W. generator. The voltage "steps up," by means of transformers, from 300 to 6,000 and then down again at the other end of the line to 110, where a portion of the current is used to operate a 10 h. p. three-phase motor, which is belted to a generator having revolving brushes, for operating drills for mine work. A 10 h. p. mining locomotive is running back and forth over a short section of track. A 200 K. W. railway generator furnishes current for the cornice lighting of the various buildings and for running the tower elevator motor. A 150 K. W. Edison generator supplies the lamps in the electric fountain and the search light on tower. The display of pumping machinery and of instruments is a very large and interesting one.

A complete railway truck with G. E. 800 standard equipment and series-parallel controller is shown. Eight arc machines supply current for four hundred lamps for lighting the drives and some of the concessions. A 6,000 light alternator furnishes the current for inside incandescent lighting at night and also for a small search light, which assists in the fountain illumination. Mr. F. H. Dorr has charge of all General Electric Co. exhibits at the Fair.

Lieut. W. F. C. Hasson is Chief of the Midwinter Fair Electrical Department and to his skill and energy is due the great success of the electrical features of the Exhibition.

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[1] A Birdseye View of the Fair, with numbered references, will be found in THE ELEC. ENGR., Vol. XVI., No. 292, Dec. 6, 1893, page 495.

LITERATURE.

Progress in Flying Machines. By O. Chanute, C. E. New York. Am. Engineer and Railroad Journal. 8vo. Illus. Price, $2.50.

This is an extremely interesting book, to which Mr. Chanute's deep study of his subject gives special value. There are many who believe that while occasional flight may become possible by means comparatively simple, open to everybody, sustained aerial navigation will owe its eventual success to electricity in some form or another. In this book will be found a vast amount of useful and instructive data bearing upon such points. Not only does Mr. Chanute give us the early chronology of the art, but he discusses in full the experiments of such men as Maxim, Lilienthal, Hargraves and Langley, and handles the various theories they advance. As an engineer Mr. Chanute is able to prick many a bubble and fallacy, while his genuine enthusiasm for the subject leads him to examine carefully into the most unlikely project. A good book often does much to establish the fact that a new art has come into being, and the present volume will in time we think come to be regarded as the pillar which stood at the parting of the ways between failures of the past and the triumphs of the future. We trust that the book will have a large circulation. It is highly suggestive and touches so many fields of modern inquiry of invention that we can hardly believe any progressive scientist or engineer would care to deny himself a perusal of it.

Transmissione Elettrica del Lavoro Meccanico. By Giuseppe Sartori. Milan, 1894. Ulrico Hoepli. 411 pages, 6⅛ x 9 inches. Price, $2.55.

THE author has given us a very clear account of the laws and principles underlying the various methods now employed in the electrical transmission of power. He treats in succession of the methods of transmission by continuous and alternating currents and illustrates their application by descriptions and a number of typical power transmission plants. Throughout the work we can trace the influence of American and English electrical engineers on the trend and method of treatment of electrical problems at the present time. We also note the adoption in Italian, as in other European languages of the term "feeder" for which there appears to be no equivalent or, at least, no such short or significant a term. The book is well illustrated and accompanied by a very comprehensive index.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. · Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, Philadelphia Representative, 1018 Chestnut Street, } W. F. HANKS.

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - -	per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies, - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

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Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

VOL. XVII. NEW YORK, MAY 9, 1894. No. 814.

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AMENDMENT OF THE PATENT LAW.

CONGRESSMAN HALL, of Minnesota, has introduced a bill amending the present patent law in a number of important particulars, which has been referred to the House Committee on Patents and ordered to be printed. Section 4887 of the present law, having reference to the effect of a prior foreign patent upon the duration of the term of a domestic patent, is so amended that the domestic application must be made within one year after the date of the foreign patent. The limitation of time imposed by the present statute relates to public use or sale in this country only. Another important, and perhaps questionable provision, apparently inserted for the benefit of some of the leading electrical corporations of the country, is that no patent *now in force*, or hereafter granted, shall have its term limited by the term of a prior foreign patent for the same invention, unless the date of the foreign patent is prior to that of the *application* of the domestic patent. The circuit courts, it will be remembered, have held that the date of the foreign patent relates to the date of issue and not that of application of the domestic patent, and this much vexed question is now before the Supreme Court of the United States for final decision on appeal. Patents which may have actually expired by virtue of the statutes in force prior to the passage of the act are however excepted from its provisions. Among the provisions affecting the practice in the Patent Office, is one reducing the period of time allowed for amendment after action in the Office, on applications herereafter filed, from two years to six months. Licenses are required to be recorded as well as assignments, a much-needed reform. There is now no statutory limit of the time during which an action for infringement must be commenced after the expiration of a patent ; this period is limited by the act to six years. Under the present law and practice, a complainant may bring suit to recover, at his option, either profits made by the infringer or damages suffered by himself ; the new act permits him to recover both, and also provides that a verdict for the plaintiff shall in any event be for not less than two hundred and fifty dollars, exclusive of costs. Courts of equity are empowered to pass the title of patents by decree, when necessary to enforce the equitable rights of the parties, and such decree must be recorded in the Patent Office. Patentees are not permitted to bring suit for infringement against individuals who have purchased infringing articles in good faith and in the open market for their own use, until the validity of the patent has first been established by decree of a court of competent jurisdiction, unless such person shall have refused to give the name and residence of the party from whom the infringing article was purchased. In any case, the remedy of the patentee against an innocent purchaser is limited to injunction, and the cost must be paid by the plaintiff. There are a number of other minor provisions which need not be rehearsed.

For the most part, the changes proposed seem to be in the right direction, and are such as will be likely, when rightly understood, to commend themselves both to patentees and to the public. Some abuses which have grown up under the present law and practice will be swept away if the new act becomes a law, and it is not, at first sight at least, apparent that it is likely to work any serious hardship to legitimate existing interests.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE meeting of the Institute this month at Philadelphia, promises to be one of unusual interest and importance as the programme already printed shows. The Institute is just completing the first ten years of its existence and entering upon a term of even greater usefulness and activity. It has enjoyed steady prosperity for six or seven years past, and it now appears that 1893–4 will be its best year up to date. Mr. Pope, the secretary, informs us that the number of new members who have qualified this year is 160 and that before the fiscal period ends this month, it will reach 175. This is a showing that might well be called magnificent, in view of the general state of depression in all branches of electrical industry, and the fact that a great many electrical engineers have found it hard work to maintain their ground or gain a footing. The Institute will begin its second decade 800 strong, or far larger in membership than its most sanguine and devoted friends dared hope a few years ago.

That the Institute is so progressively flourishing is the best proof that could be given of the esteem in which it is held and the desire of all the members to second the efforts put forth by successive presidents and councils to promote its dignity, influence and welfare. It is possible that a few mistakes may have been made by the management, as some of the more acute and vigorous of its critics allege, but these mistakes, if such were made, are assuredly nothing more than minor errors of judgment from which a society or an individual can hardly ever be absolutely free. On the whole, and throughout, it is safe and true to affirm that no technical body in this country has a higher, brighter, cleaner record as to its policy and its work, than the Institute; while perhaps there is none that has been freer from "cliques" or has sustained from first to last so little deserved adverse criticism. It is only to be hoped that as the years roll by, the newer men entrusted with its destinies will be even more zealous, if possible, than their predecessors, to promote its success and increase its usefulness as the national society of the electrical engineering profession in America.

The meeting begins at 10 a. m., on May 15, and will last four days.

A CONTACT RAIL, STORAGE BATTERY RAILWAY.

We devote considerable space this week to an illustrated description of the Johnson-Lundell electric railway system, which has been under experimental test in this city for some months past. To all appearances, it is a most important advance in the art, combining very ingeniously all the great advantages of both the closed conduit method and the storage battery car, and abolishing at one stroke all the evils of the overhead wire. Moreover, several new features are introduced in the car, which has but one motor specially geared in such a way as to obtain the benefits of series-parallel control, with an ability to govern the motion of the car entirely through the switch handle. A system so thoroughly and cleverly worked out as this seems to be, makes a strong bid for the public favor denied the trolley.

LETTERS TO THE EDITOR.

CONNECTING FIELD MAGNETS TO BUS BARS.

IN Mr. Van Nuis' article on "Connecting Field Magnets to Bus Bars" in your issue of May 2, he remarks that the method shown in my sketch (ELEC. ENGR., April 11, 1894) combines the field switch with the rheostat "in such a way as to bring the opposite poles of a circuit into dangerous proximity." Why into dangerous proximity? The poles are no nearer together than in the double-pole main switches generally used on switchboards.

When a machine is to be shut down by the arrangement shown in my sketch the lever passes off the last rheostat point before making contact with the short circuiting point, but even if contact were made with both points at once the circuit is only closed through the entire resistance of the rheostat which is sufficient to prevent considerable flow of current.

As to the increased complication and cost of the rheostat, it consists in one extra contact point and one extra binding post.

WM. A. ANTHONY.

VINELAND, N. J., May 3, 1894.

PATENT NOTES.

PROF. FORBES' DYNAMO PATENTS.

ON May 1, three patents were issued to Prof. George Forbes, which are said to embody some of the principal features of the 5,000 h. p. dynamos about to be installed at Niagara, and which were discussed in Prof. Forbes' paper read before the Institution of Electrical Engineers.[1]

One of the patents describes very clearly the objects which had to be attained. The first object was a possibility of winding the machine to get a high E. M. F. as safely in the machine itself as in a step-up transformer. This can be done in a large machine of 5,000 h. p., where the space occupied by insulation need not bear the same proportion to the space occupied by wire as in a smaller machine and where oil circulation can be employed. It can be accomplished by having the armature stationary, especially if the shaft be vertical. The position has been taken up by Prof. Forbes that it is possible to do away with the cost and losses in a step-up transformer, that the large stationary armature is as safe to wind as is the step-up transformer, and if the difficulty of using very high electric pressures in the dynamo be shirked it must be faced in the transformer.

The next three objects were all attained by one simple expedient. These were (1) to get mechanical security having in mind the enormous centrifugal forces at a speed of 250 revolutions a minute; (2) to have a maximum of fly-wheel momentum with a minimum of weight, and (3) to prevent the magnetic pull from assisting centrifugal force to rupture the revolving part. These were all attained by the simple expedient of making the revolving fields external to the armature.

It is said that every one of the designs submitted to the Cataract Company had a separate fly-wheel which increased the weight to be supported by the hydraulic piston in the turbine beyond what it was capable of supporting. In all the designs the magnetic pull between the field poles and the armatures helped centrifugal force to break the revolving part, and in those with revolving fields the field coils were held in by pole faces held in place by bolts and keys, a source of weakness considering the high centrifugal forces.

Owing to the great diameter of the revolving part there is a maximum momentum with minimum weight, and all need for a fly-wheel is done away with. When the load is removed, and while the turbine-governor is cutting off the water, this enormous momentum prevents the machine from varying its speed unduly. Moreover, the magnetic pull between the pole pieces and armature diminishes very appreciably the tendency of the centrifugal force to break the fly-wheel; while the pole pieces and their coils are all held securely by the centrifugal force against the interior of the ring which forms at once the fly-wheel for the turbine governor, and the yoke for the field magnets. Further, the central armature being fixed can be wound for very high electric pressures.

Of the two other patents issued at the same time to Prof. Forbes one refers to the notching of the armature to hold two types of coils which overlap each other; and the other a method of enclosing the armature coils with an envelope and circulating oil through the coils, to carry off the heat and to provide for high insulation.

PERSONAL.

MR. H. NEWMAN LAWRENCE, M. I. E. E., is to lecture before the Department of Electricity of the Brooklyn Institute on May 22, on electro-therapeutical subjects. which will be treated in a broadly popular way.

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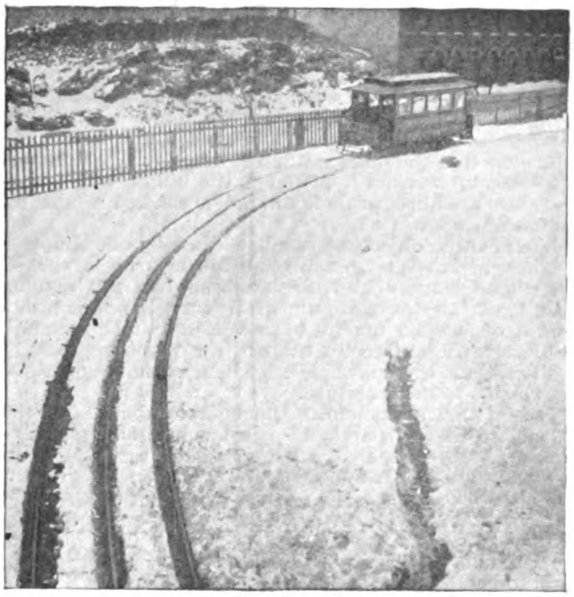
[1] See abstract THE ELECTRICAL ENGINEER, Dec. 20, 1893, *et seq.*; illustrations, March 14, 1894.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE JOHNSON-LUNDELL ELECTRIC RAILWAY SYSTEM.

The rapid advances of late years in the domain of street railways have wiped out the horse, and have left the field to the rivalry of but the cable and the trolley. To both of these, the public raises objections which increase yearly in bitterness and in sound argument, and for both a successor is earnestly looked. These are plain facts within the knowledge of every resident of a large city. The cable, it is admitted, is not only expensive in its first cost, but has a fatal interdependence as the result of which a slight casual imperfection at any point immediately paralyses the whole service, even when a duplicate cable is provided. Its vagaries, when trouble happens, are well known, and no city in which the cable has been introduced escapes the sensational spectacle of cars running wildly along its principal thoroughfares, spreading disaster right and left, until the power house can be notified to shut down, when miles and miles of unaffected track are also thrown into disuse. A cable car must go forward or not at all, and the consequent obstruction or dislocation of street traffic becomes daily more apparent to everybody.

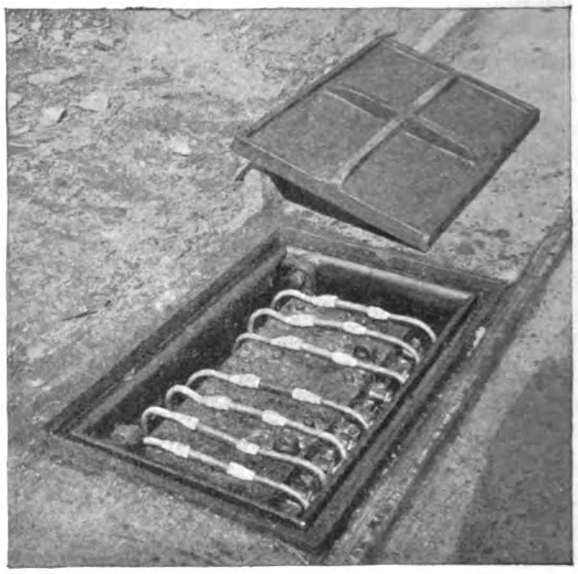
The defects of the trolley are also well known and their recognition has led to the quest, by numerous inventors, for a method which shall do away with the entire overhead structure. This has been attempted in various ways by the devising of underground railway systems which may be broadly divided into two classes, namely, the open conduit and the closed conduit. In the former, the current feeding conductor is put in electric connection with the car by means of a "plow" or other contact device but always requiring an open slot which allows water and mud and other street debris to enter the conduit and for the removal of which special provision must be made. Besides this, where bare conductors are used there is the constant source of loss and trouble due to leakage from moisture. As a consequence, we find not a few devoting their attention to the second type, the closed conduit, but up to the present time none so far suggested has met with sufficient favor to lead to its permanent adoption on an actual road.



Track of Johnson-Lundell Electric Road in Winter.

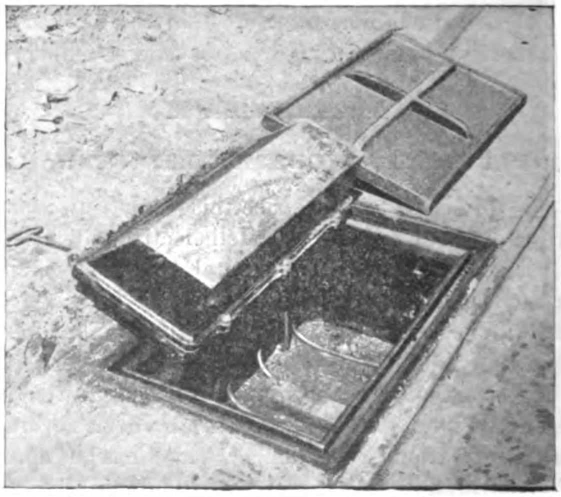
Recognizing the necessity of a closed conduit type for city traffic and not unmindful of the difficulties to be overcome, Mr. E. H. Johnson, the pioneer associate of Mr. Frank J. Sprague in the electric railway industry, together with Mr. Robert Lundell, some time since set about to devise such a system, keeping in mind the following salient features: 1. To dispense with all overhead wires. 2. To replace it by a system of wiring which shall essentially duplicate or imitate that of the former trolley lines, but shall all be out of the way and out of sight under the street paving. 3. The car to have all the advantages of an automobile vehicle, in case current from the distant power house shall be shut off temporarily from any cause, or dislocated at any point. 4. That under any and all conditions the car shall be under the highest degree of control.

These conditions, it will be admitted, are of the most exacting nature, but it is believed that they have been met and their success demonstrated in the short experimental road which has been in continuous operation in New York during the past winter, and of which we give several illustrations.



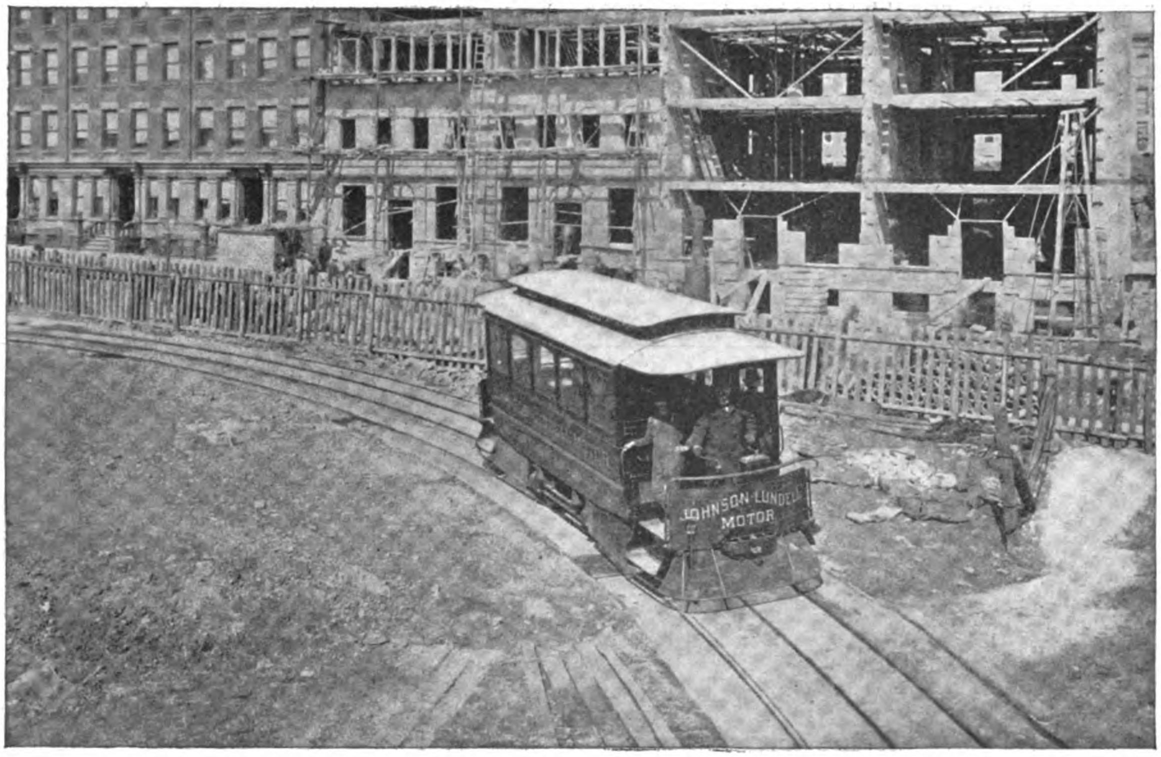
Switch Box Uncovered, Johnson Lundell Electric Railway.

The track runs around a whole city block, with stiff grades and with curves of necessarily short radius. The power house is at the foot of the hill and at the centre of that section of the track or circuit. The generating plant comprises a vertical engine driving directly a pair of Lundell dynamos, the unit being such that it could be enlarged on exactly the same proportions up to any size for any road. By means of the Interior Conduit telescopic iron tube, current is carried to the track at the proper points of feeding, and is distributed without any loss due to leakage or conduction, owing to the high insulation of the ducts.



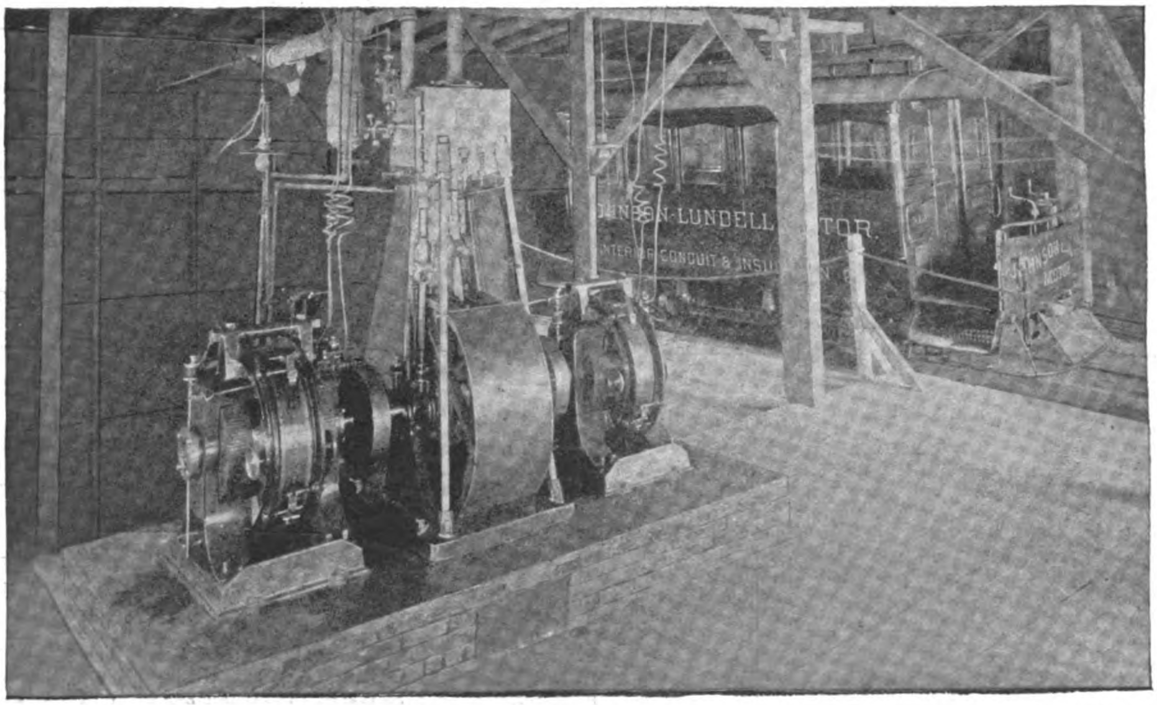
Switch Box Thrown Back, Johnson-Lundell Electric Road.

The track itself is of ordinary construction as to the rails. Between the rails it is asphalted or paved—examples of both are shown—and paralleling the rails lies a conducting bar or strip of metal embedded in the asphalt. The bar is level with the surface, and is divided up into sections with insulating blocks of stone or other material between them. Just outside the single track, or midway between the double tracks, are plain boxes with iron covers flush with the street surface. In these boxes are electromagnetic devices which deliver current to each section as the car comes along, and then lie dead until the succeeding car rolls up. These switch boxes are watertight and each box governs its particular sections of track.



Appearance of Johnson-Lundell Electric Railway Track, Showing Third Rail in Centre.

The car carries a pick-up rubbing brush which leads the current into the motor and which takes the place, or fulfils the function of the trolley wheel. In fact, if a man were to stand on his head, and if paving stones were made of glass, he would see underneath a literal counterpart or reproduction of the trolley system, so far as the track itself goes. There is one great difference, however, which the eye does not reveal. The trolley system is alive throughout. This is not alive anywhere except at the point over which the car is passing. The difference of potential between the two exposed sides of the circuit between which the car moves is *nil*; hence there is no danger to horse or passer-by.



Power Plant, Johnson-Lundell Electric Road, New York City.

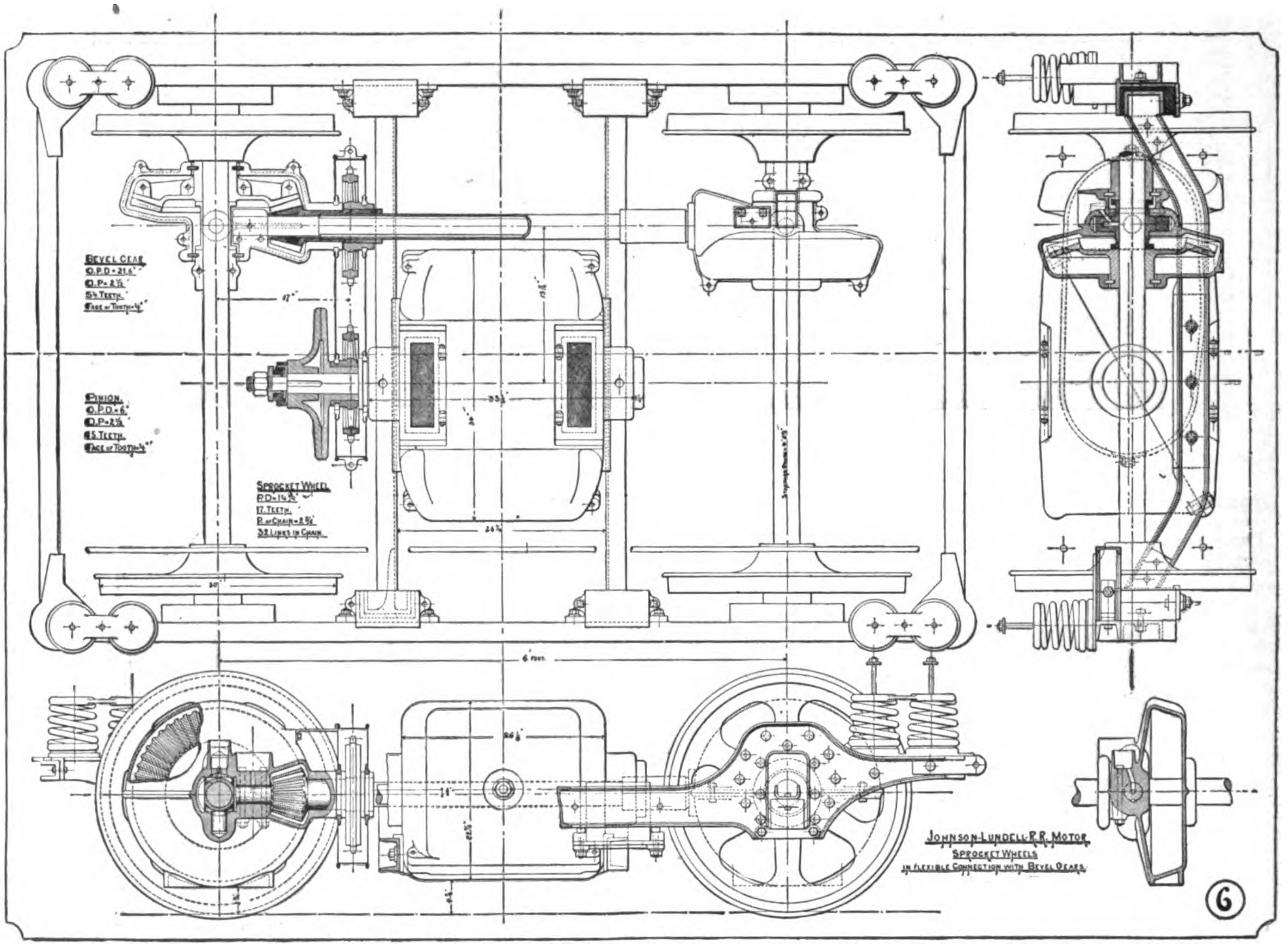
We next notice the car, whose mechanism is shown diagrammatically. In the first place it is noteworthy that the car has but one motor, a feature toward which all the first class electrical inventors have been directing their energies for years. This motor is central under the car and drives on each axle by means of bevel gear, and with sprocket wheels and link chain in flexible connection with the same. Its suspension is flexible, the bevels are boxed, the sprocket wheels and links mesh noiselessly; and thanks to the intervention of a bipartite screw coil in close relation to the armature shaft, the motor, though capable of instantaneous arrest or sudden starting, never starts or stops with a jerk. The motor is, moreover, iron cased and protected against dirt, stones, moisture, etc.

Underneath the car is the steel brush which gathers up the current and passes it to the motor, the return being as usual through the rails, which are obviously harmless, as the conducting strip between them is only alive when a car is right over it. But the car is not dependent merely upon the supply of live current. Under the seats are frames holding a very simple, elementary form of lead storage battery, enough to furnish the voltage at which the motor runs—300 volts—and though with very few plates in each cell, giving considerable capacity. We have here at once a combination of great value. The batteries always remain in place and are not changed and need practically no attention; but at a moment's notice they furnish current and can carry the car through any emergencies. The batteries also play one or two parts in the internal economy of the car—"picking up the circuit" for a second when it starts; lighting the car, etc. But their great value lies in the fact that they render the car at once self-contained and dispense with the usual costly, complicated and troublesome wiring at crossings, switches, steam-railway tracks, etc. If the car has not sufficient headway to run over a crossing, the battery will do that, and if necessary, keep the car going for several miles should it be deprived of central station current or even put on a line that is without electricity.

Another valuable feature of the Johnson-Lundell system is the method of car control which is effected by the movement of but a single lever in charge of the motorman. The movements of this lever not only bring about the electrical changes that control the varying speeds of the car but they also replace the brake, since the car is brought to a stop by electrical means entirely, the motor being converted into a generator and delivering current to the line. This method of braking is not only highly economical but its smoothness of action can only be compared to that of a buffer working against an air cushion.

Having in mind the abnormal amount of current taken by street railway motors at starting, and the large motor capacity required under the present conditions, the Johnson-Lundell gearing arrangement is such that the load is picked up gradually. The car is thus enabled to start off with great smoothness and the current consumption is cut down to that actually required to effect the necessary acceleration, and no more. The effect of this economy in current required by the motor is reflected back directly to the power house and to the coal pile.

As stated above, the Johnson-Lundell car and underground system has been in continuous operation since the beginning of the winter just past and thus far no defects or difficulties of any kind have developed. Our engravings are made from photographs taken during the winter. The car ran through thick snow, and switch boxes were frequently opened and exposed without any disturbing effect. The severe trials to which it has been successfully subjected would seem to indicate that the Johnson-Lundell system, which is being introduced by the Interior Conduit and Insulation Co., of Broad street, N. Y., offers a practical solution of the most important problem now confronting electric railway companies.



JOHNSON-LUNDELL RAILWAY MOTOR—PLAN AND ELEVATIONS.

ELECTRIC RAILWAY WORK IN MARYLAND.

Arrangements have been completed for constructing the Pikesville, Reisterstown and Emory Grove Electric Railway. Henry A. Parr will be president of the new road.

The total authorized issue of bonds is $250,000 and of stock 2,500 shares, at a par of $100. Under the existing agreement no more than $185,000 of the authorized issue of bonds are to be sold until the road is completed and ready for operation. The bonds are to bear interest at 5 per cent. and are redeemable in forty years.

The total length of the proposed road will be 10¼ miles. It will start from the terminus of the Pimlico and Pikesville electric road at Pikesville. The electric line will follow the turnpike from this point through Cross Keys, Owings's Mills, Smoketown, Reisterstown and thence to Glyndon and Emory Grove.

THE PROPOSED NEW YORK–PHILADELPHIA RAILWAY.

The May number of *Transportation* of this city devotes considerable space to the description of the electric railway which it is proposed to build between New York and Philadelphia, and prints, as a supplement, a large map of the route. The Central Jersey Traction Company, with headquarters at 2 Wall street, has been organized and the officers and directors elected are: Hon. Frank A. Magowan of Trenton, president; ex-Sheriff E. W. Hine, of Newark, vice-president; J. H. Baldwin of Newark, secretary; James H. Darrah of Trenton, treasurer; George G. Crosby of New York, J. H. Tingley of Rahway, and Joseph Reall of Bloomfield, N. J., directors. A charter will at once be secured in Pennsylvania for the line between Trenton and Philadelphia, via Bristol, Holmesburg and Frankford, probably connecting with the proposed electric railway at the latter point, well within the city limits to 9th and Market streets, the business centre of Philadelphia, and within a few blocks of the Pennsylvania and Reading Railroad stations. This line will connect the Consolidated Traction Company's roads in Jersey City and Newark with the Philadelphia Traction Company's lines in Philadelphia, both of these roads being controlled by the same interests.

The plan is not only to construct a through line of electric railway to connect the principal points in the State of New Jersey with each other, and with New York and Philadelphia, but to consolidate the local lines in different places into one system. These lines embrace about seventy miles of paying roads, outside of Jersey City and Newark, and their value will be greatly increased by the earnings effected through consolidation, and by the increase of business from the through line.

MISCELLANEOUS.

MAGNETIC QUALITIES OF IRON.[1]

BY J. A. EWING, F.R.S. AND MISS HELEN G. KLAASSEN.

In this paper the authors describe a series of experiments on rings by the ballistic method, and dealing mainly with the effects of cyclic variations in magnetizing force. A modified method of testing was employed which, while requiring only one current and one magnetizing coil, retains the advantage that each point in the cycle is reached by a single step from the end of the cycle. A section at the end of the paper relates to the molecular theory of magnetization, and its adequacy to explain the characteristic manifestations of magnetic hysteresis.

The results of these tests lead the authors to make the following comments on Steinmetz's "Law of Hysteresis":

In a paper read before the American Institute of Electrical Engineers[2] on the "Law of Hysteresis," Mr. C. P. Steinmetz has discussed certain experiments on the relation of $\int H\,d\,l$ to B, and contends that the empirical formula

$$\int H\,d\,l = \eta B^{\cdot 6},$$

where η is a constant factor, is in good agreement with the results of experiment. From the figures Mr. Steinmetz gives, and from those which our own experiments supply, it appears that within a certain range of values of B this formula may be taken as giving a fairly close approximation to the real value of $\int H\,d\,l$. As an empirical formula of the kind is of use to designers of transformers, we have been at some pains to examine how nearly and within what range a formula of this type may be taken to represent the facts. It will suffice to refer to one example in some detail.

Taking Ring IV. (thin sheet iron) for which we have a numerous and very consistent series of determination of $\int H\,d\,l$, extending from $B = 43$ to $B = 14{,}720$, we have tested the constancy of the index ε in the formula

$$\int H\,d\,l = \eta B^{\varepsilon}$$

by plotting log B in relation to $\log \int H\,d\,l$.

From $B = 2{,}000$ to $B = 8{,}000$, the curve obtained in this way is a good straight line giving the value 1.475 for the index ε, and 0.01 for η. When B is about 8,000 the inclination of the line changes, and from $B = 8{,}000$ to $B = 14{,}000$ we again obtain very nearly a straight line giving $\varepsilon = 1.70$ and $\eta = 0.00184$. Again, the measurements obtained from the small cycle tests of Ring IV., show that from $B = 200$ to $B = 500$ the curve of log B and log $\int H\,d\,l$ is very closely a straight line, giving $\varepsilon = 1.9$. Where B is above 500 the gradient of the line gradually changes. Taking the region from $B = 500$ to $B = 1{,}000$ the value of ε is 1.68, while from $B = 1{,}000$ to $B = 2{,}000$ it is 1.55.

From these results it is clear that no formula of the type under consideration, with a constant index ε will serve to represent the results within anything like the limits of experimental accuracy. The index begins by being 2 or nearly 2, (a result which follows also from Lord Rayleigh's experiments).[3] In the ring referred to, this decreases to about 1.47 in the region of high permeability, and then increases again to 1.7 when the "wendepunkt" is passed. The changes in the index, indeed, correspond to the passage from one to another of the familiar successive stages in the process of magnetization; comparatively high values of the index are found first in the initial stage of low permeability, and again in the stage of strong magnetization when the permeability is reduced by the approach towards saturation, while in the intermediate stage where the curve of B and H is steep the index is decidedly low. The well marked changes of gradient curve which characterize the magnetizing are accompanied by scarcely less well defined changes on the part of the index ε and the factor η in the empirical formula devised by Mr. Steinmetz.

While, therefore, a formula of this type cannot be admitted to have any physical significance, it may still be serviceable in giving rough approximations for the purposes of the electrical engineer. Though the formula is by no means to be accepted as an equation to the actual curve of $\int H\,d\,l$ and B, the curve which it gives by a suitable choice of index ε and factor η lies fairly close to the actual curve, intersecting it at an intermediate point as well as at two extremes. And it is the case that an index of 1.6, or a number approximating to that, gives a curve lying generally in the neighborhood of the true curve throughout the range of B, which is of most practical importance. In the case of our Ring IV., for instance, the formula

$$\int H\,d\,l = 0.0034\,B^{1\cdot 6}$$

give values of $\int H\,d\,l$ which are nowhere (within the range of these experiments) so grossly divergent from the truth as to unfit them for use in calculations connected with transformer design.

The divergence becomes considerable at the top of the range, but elsewhere the agreement is fair. It should, however, be observed that if we wish to make the curve given by the empirical formula coincide with the real curve throughout any short part of its range, other, and often very different values must be given to ε and η. Thus, if the part from $B = 2{,}000$ to $B = 8{,}000$ only is considered—a part which includes those values of B which are usual in transformer cores—the formula $\int H\,d\,l = 0.001\,B^{1\cdot 475}$ will express the results very much more closely.

Throughout this not inconsiderable range of magnetization (the region, namely, of high permeability) the agreement is good, but other empirical constants are required to fit the earlier, and again the latter parts of the curve.

TRANSPARENT CONDUCTING SCREENS FOR ELECTRIC AND OTHER APPARATUS.[1]

BY W. E. AYRTON, F.R.S., PAST-PRESIDENT, AND T. MATHER, ASSOCIATE.

It is well known that electrostatic instruments require to be screened from outside electric disturbance, in order that their indications may be correct; but it is not so generally recognized that instruments intended to measure small forces, such as certain types of *electro-magnetic* voltmeters, delicate vacuum gauges, etc., are liable to give wrong readings from an electric attraction being exerted on the pointer, such as is produced by the glass cover when it is touched or cleaned.

The authors then showed, how, by merely stroking the outside of the glass cover of a 100 volt voltmeter, unconnected, the pointer would indicate 80 volts; and when connected to 100 volt mains would only indicate 40 volts.

They next considered whether it was not possible to make a perfectly transparent conducting screen, so that, while the electrostatic screening of the pointer should be practically perfect, the pointer and dial should be as easily seen as if the screen were not present. After much experimenting, they arrived at the following two methods of coating a glass cover, or shade, which gives perfectly satisfactory results:—

No. 1.—Dissolve ¼ ounce of transparent gelatine in 1 ounce of glacial acetic acid by heating them together in a water bath at 100° C. To this solution add half the volume of dilute sulphuric acid which has been prepared by mixing 1 part of strong acid with 8 of distilled water by volume, and apply the mixture while still warm to the glass shade, which should be previously polished and be warm. When this film has become very nearly hard, apply over it a coating of Griffith's anti-sulphuric enamel.

Method No. 2.—Thin the gelatine solution, prepared in the manner previously described, by the addition of acetic acid (say 2 volumes of acid to 1 of the solution), and, after polishing the glass, float this thinned solution over the glass cold. Drive off the excess of acetic acid by warming, allow the glass to cool, and repeat the floating process, say, twice. Thin the anti-sulphuric enamel by the addition of ether, and float it over the gelatine layer applied as just described. Expel the ether by heating, and apply a second layer of this thinned anti-sulphuric enamel.

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[1] Abstract of a paper read before the Royal Society.

[2] *Transactions* of the Institute, January 19, 1892, vol. 9, p. 3.

[3] *Phil. Mag.*, March 1887.

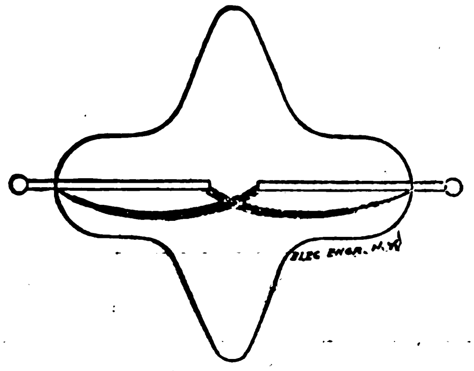
[1] Abstract of a paper read before the London Institution of Electrical Engineers, April 12, 1894.

With experience a layer can be applied, either according to method No. 1 or No. 2, so that, when finished, it is quite hard to the touch, and so transparent that it is only by looking at the glass plate obliquely that the presence of the varnish can be detected. It is also so conducting that when a P.D. of several thousand volts, alternating with a frequency of 200, is set up between the needle and inductors of one of our electrostatic voltmeters, the pointer, which is metallically part of the needle, is not visibly attracted by a metallic rod held just outside the glass close to the pointer, this metallic rod being electrically connected with the stationary inductors.

ELECTRIC DISCHARGE THROUGH GASES.

PROF. J. J. THOMSON recently delivered a lecture at the Royal Institution on "Some Properties of the Electric Discharge through Gases."

The author first dwelt on the association between many chemical and electrical effects. Of recent years the number of electrical phenomena which were inseparably connected with chemical action, had increased so much that they could venture to hope that some of the most important questions in chemistry and electricity would be recognized as being but different aspects of the same phenomenon. No phenomena were more suited to prove the connection between electrical and chemical effects than those which formed the subject of his remarks that evening, for here they had got matter in a state in which its laws were most accurately known, and the electrical effects were rendered more easy of accessibility. In other words, they obtained ocular and not circumstantial evidence of what was going on. The lecturer next went on to consider some of the phenomena connected with the transference of the electric discharge from gas to the electrode, and some properties of the discharge when it was confined in the whole of its course to the gas, and when it passed from the metal into the gas or from the gas into the metal. A great deal of information could be got on these points if they observed a discharge through a very long tube. He had observed, by means of a rapidly rotating mirror, the discharge in a tube 50 feet long. From the appearance in the mirror it was evident that the luminosity started at the positive electrode, and then swept down the tube with enormous velocity. When the discharge got near the negative electrode, its progress was checked, that is, there appeared to be a reluctance to enter the electrode, and the luminosity lingered for some appreciable time. This reluctance of the electric discharge to pass from the gas into a metallic electrode was further exemplified by means of experiments. In one of the experiments a bulb was used into which two electrodes projected; these electrodes were connected to the terminals of a high tension alternating current transformer. The spark did not pass from one end of the electrode to that of the other, but followed the gas as long as possible, and impinged at the place where the electrode joined the glass bulb. This curious effect of a double arc is shown in the accompanying illustration.



DOUBLE ARC ELECTRIC DISCHARGE.

The difficulty electricity experienced in getting from a gas to the electrode depended a great deal on the nature of the gas and the electrode. The lecturer then proceeded to show this by means of experiments. Oxygen gave a strong positive electrification, while with hydrogen it was different. The electric discharge from an oxidized copper electrode in hydrogen was negative till the oxide was reduced, when it became positive. Of the gases themselves he had found that oxygen gave a strong positive electrification, while with hydrogen it was different in various parts of the bulb.

The transference from gas to electrodes, said the lecturer, was facilitated by chemical combination between the gas and the electrodes. They might go further and say that something of the nature of chemical combination between those two was necessary for the transference of electricity. Passing on to consider the discharge through gases without electrodes the lecturer deduced the conclusion that the conductivity of gases at a certain degree of rarefaction was greater than that of any metal, and almost infinitely greater, molecule for molecule. For the purpose of these latter experiments Prof. Thomson used the outsides of two Leyden jars, the insides of which were connected to a Wimshurst machine. A wire connecting them externally was made into a coil, in the centre of which were placed bulbs containing the gases to be experimented upon. When the two gases were to be compared two coils were employed.

Another interesting experiment was that of a bulb placed inside another, the latter of which retained traces of mercury vapor; the discharge at first took place in the interior bulb, but upon increasing the density of the mercury vapor by slow heating the discharge took place in the space between the two bulbs. The concluding experiment showed the influence of a magnetic field on the electric discharge.

THE LIGHTING OF "UTOPIA, LIMITED."

The Broadway Theatre has at present what is probably the finest example of stage wiring in the city. This is the more remarkable when it is understood that about one week elapsed between the placing of the order and the completion of the work, at the end of which time the Board of Fire Underwriters gave it their approval without change on the first inspection.

Those who have seen the production of "Utopia, Limited" will remember the brilliant, almost startling, effect of the lighting in the second act, but probably few realize the amount of labor and careful attention to detail that has been expended to bring about the result. The lighting in this act is wholly decorative; there are no changes, and after the curtain rises the switches are not touched until it falls again; but all this time nearly 450 lamps in borders, wings, foot lights, and flies and on the hangings of the audience chamber and the throne shed a perfect blaze of light upon every nook and corner of the stage; a light more powerful than intense, however, and entirely without any unpleasant glare.

The work was all done from a photograph (and a very bad photograph at that) taken by flash light in London after one of the performances there. This was put in the hands of James Stewart, the electrician, with instructions to duplicate it. He had about two weeks to do so and immediately went to work. He did not know how many lights were required, nor how the management expected him to arrange them but his experience of theatre lighting had taught him not to let a little thing like that trouble him much, and he has succeeded, it is said by the London actors, in far surpassing the original.

In the first place there is not a particle of "temporary work" in the entire installation. Washburn & Moen white core wire and flexible cord are used, the latter rubber-covered on both legs and the former run in heavy moulding. The sockets are of the Edison pattern and the circuits are controlled by a 200 ampere Ajax triple pole switch and numerous Bryant covered cut-outs. There are 18 stage pockets to which current is led from the dynamo room by means of 1,000 feet of No. 0 main, besides which 500 feet of No. 8 flexible cable runs from the fly gallery to the borders, and 8,000 feet of No. 14 wire and 1,500 feet of flexible cord has been required; the former for the wiring concealed in the mouldings and the latter to connect the pockets, etc. On each border is a cut-out from which circuits are distributed to smaller cutouts each controlling a circuit of no more than six lights depending from the edge of the border and lighting the flower baskets and ornamental pendants. A large wooden frame is fastened against the back of each border and serves the useful purpose of holding more securely the cut-outs and moulding and also keeping the lamps away from the scenery. The supplies were all furnished by J. Jones & Son, of 67 Cortlandt street, this city, through their representative, Mr. J. C. Moulton, who has had a wide experience in this class of work, and everything was done under the personal supervision of Mr. Stewart.

The three wire system is employed throughout. Current is generated by two No. 12 Edison dynamos in the basement driven by Armington & Sims engines, and a double throw switch is provided to cut in the street circuit instantly in case of a breakdown. The house wiring is enclosed in brass interior conduit, and every part of the system is regularly tested to avoid the possibility of trouble. The electric gas lighting circuits are also regularly tested, and the house can be thus lighted instantly in the very improbable event of both the street current and the theatre plant giving out at the same time.

The utmost discipline prevails throughout the lighting department, and strict records are kept of the condition of circuits, date of repairs, date of renewing each lamp, etc., so that the chief electrician has at his finger's end all the data relating to every branch of the work for which he is responsible.

TRIPHASE POWER TRANSMISSION AT COLUMBIA MILLS, COLUMBIA, S. C.

On Tuesday, April 24, there was started in Columbia, S. C., a power transmission plant of exceptional interest, in the development of a new and important field in the application of electric motors to the manufacture of textiles.

The Columbia Mills Company (an organization composed mainly of New England capital) have had in contemplation for some time the erection of a large cotton mill in Columbia, S. C., to take advantage of the situation as regards supplies, labor and a fine water power close to the town. Last year this enterprise was pushed to a conclusion, but on making the detailed plans for the work, it was found that owing to the situation of the power and land available for the mill purposes, it would be highly advantageous not to erect the mill directly at the power, but to transmit the energy for driving at a distance of about 800 feet. In connection with this, of course, all well known plans for delivery of power were carefully canvassed by the company, and by Lockwood, Greene & Company, their engineers.

After careful consideration of all the various electrical and mechanical systems, the triphase system of the General Electric Co. was selected, with special view to the uniform speed to be obtained in the motors, and the total absence of commutators and collecting devices which might cause troublesome and dangerous sparking. To further increase the efficiency of the system, it was decided to couple the dynamos to their turbines directly, although the available head (25 feet) introduced a serious limitation in the possible speed.

The total amount of power to be transmitted was over 1,000 H. P. and it was decided to divide this into two units at the generating station. Consequently two special slow-speed triphase generators were designed to meet the requirements of the case. One of these machines of 500 K. W. capacity is shown in Fig. 1. It has forty poles and operates at a normal speed of 108 revolutions per minute, giving thirty-six cycles upon the line, at a voltage of about 575 at the dynamo terminals.

The armature is ten feet in diameter, and is of massive construction. It is of the iron-clad type and is wound with a single bar per slot, heavily insulated, a construction which gives practical freedom from burnouts and other electrical difficulties. The total weight of the machine is about 100,000 pounds.

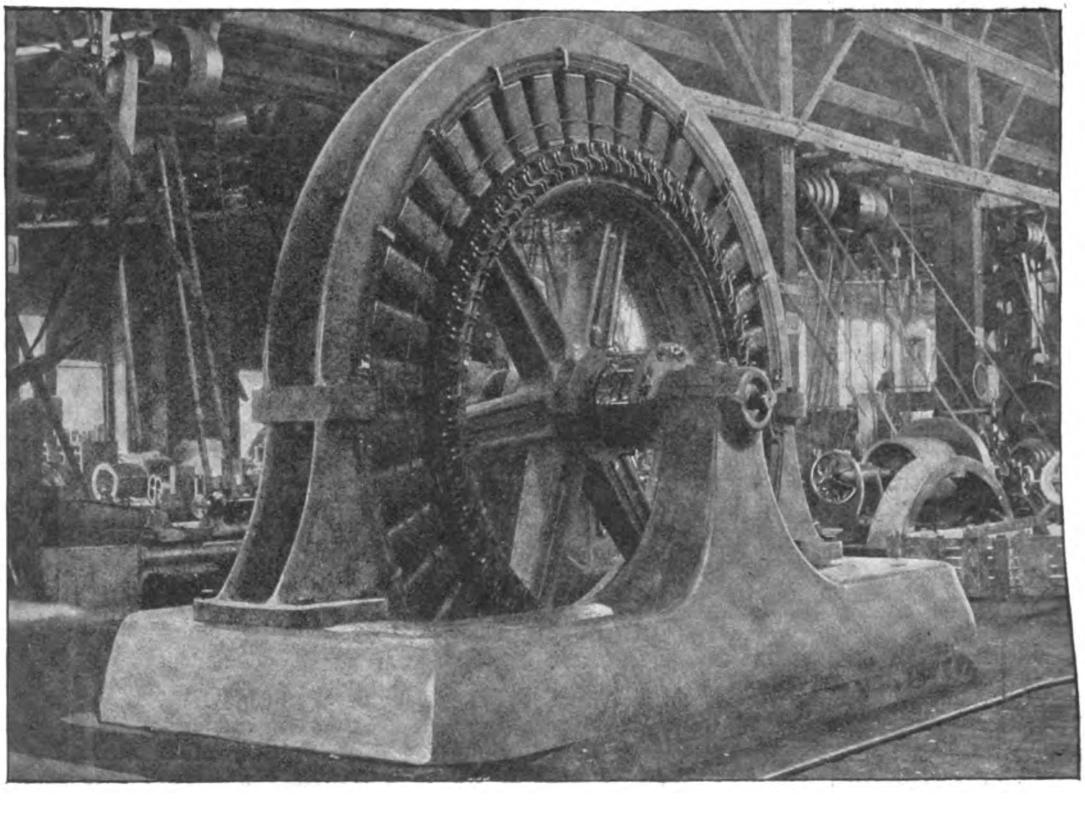


FIG. 1.—SLOW SPEED TRIPHASE GENERATOR FOR POWER TRANSMISSION, COLUMBIA, S. C.

Two of these huge machines were completed in the early part of the present year and shipped to Columbia, where the turbines were nearly ready to receive them. The power plant consists of two pairs of 48 inch cylinder gate Victor turbines made by the Stilwell-Bierce & Smith-Vaile Co., (illustrated in our last week's issue), which are directly connected to the generators. The generating station is connected with the mill by an underground conduit of planking, protected by pitch and asphalt, the bare wires being placed in position in a bedding of asphalt. The conduit thus constructed rests on a blind drain, and is carried across the canal to the power house under a bridge which is there erected.

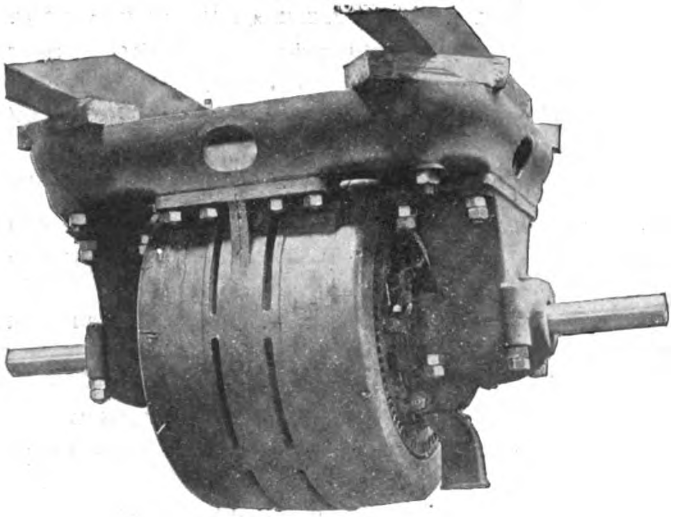


FIG. 2.

In the mill there are seventeen 65 H. P. motors, Fig 2, hung overhead and driving sections of line shafting with direct belting. The speed of the motors is 535 revolutions per minute, and varies less than 2 per cent. from full load to friction load. These machines have neither commutators nor collecting rings, and even the armature rheostat requires almost no attention, inasmuch as it is operated from the floor by means of a lever thrust into the switch socket.

All interior wiring is in conduit tubing, and the switches are boxed in. In addition to the motors, several hundred lights are wired in the mill, and can be operated either from the main circuit or in part from either of the two 25 H. P. exciters which were provided with surplus capacity with this object in view. The mill is not yet all in place, but on April 24, the big generators were started and the motors given a preliminary spin.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 1, 1894.

Accumulators :—

Storage Battery, W. A. Phillips & J. B. Entz, Bridgeport, Conn., 518,966. Filed June 20, 1893.

Employs two flat spirals of insulating wire placed with their edges together and each having exposed ends for connection to the circuit.

Storage Battery System, J. Trumpy, Hagen, Germany, 519,077, Filed Nov. 22, 1893.

The invention consists in providing auxiliary brushes at one or both sides of the main brush and connecting the former with each other and to the main by resistances.

Alarms and Signals :—

Automatic Electric Fire Alarm and Signal, L. A. & C. J. Werner, Boston, Mass., 519,213. Filed Feb. 7, 1894.

Distribution :—

System of Electrical Distribution, E. Thomson, Lynn, Mass., 519,076. Filed Aug. 5, 1889.

The invention consists in placing the local generator in a vault and leading the main or circuit of high potential to it through conduits, while the secondary wires leading to the local are provided with ground contacts.

Dynamos and Motors :—

Dynamo Electric Machine, G. Forbes, Niagara Falls, N. Y., 518,944. Filed Aug. 17, 1893.

Claim 1 follows :

The combination of a field magnet outside the armature rotated by means of a spider attached to the shaft, the spider and field forming a bell-shaped revolving field magnet, with a stationary armature.

Dynamo Electric Machine, G. Forbes, Niagara Falls, N. Y., 518,945. Filed Aug. 17, 1893.

Claim : The combination of an armature having parallel notches with two types of coils or solenoids having corresponding parallel sides, the ends of the coils of the second type being bent over the ends of the armature and passing within and clear of the coils of the first type.

Construction of Solenoids or Coils of Wire Used in Electric Machinery, G. Forbes, Niagara Falls, N. Y., 518,946. Filed Aug. 17, 1893.

Claim 1 follows :

The combination of a solenoid or coil with a close fitting casing, having an inlet and outlet for oil with a pump for maintaining a forced circulation of oil.

Field Magnet for Electric Machines, A. Schmid, Allegheny, Pa., 519,097. Filed Dec. 7, 1889.

Employs field poles composed of laminæ of sheet iron with a frame of cast iron cast about them and certain of the laminæ projecting into the cast iron frame a greater distance than the others.

Self Exciting Constant Potential Electric Generator, A. Schmid and B. G. Lamme, Pittsburgh, Pa., 519,098. Filed Feb. 20, 1890.

Employs main armature coils wound about the core, supplemental regulating coils connected in series with the main coils and others connected with the supplemental coils and a conductor for connecting the supplemental coils with the field exciting coils.

Electric Motor, F. E. Herdman, Indianapolis, Ind., 519.116. Filed July 19, 1892.

The invention consists in giving to the fields excessive strength at the time the current is thrown on the motor and reducing their strength as the motor increases its speed.

Regulator for Electric Motors, F. E. Herdman, Indianapolis, Ind., 519.120. Filed Apl. 16, 1892.

Similar in its object to No. 519,116.

Controlling Device for Electric Motors, F. E. Herdman, Indianapolis, Ind., 519,121. Filed July 19, 1892.

Similar in its object to No. 519,116.

Controlling Device for Electric Motors, F. E. Herdman, Indianapolis, Ind., 519,122. Filed July 19, 1892.

Similar in its object to No. 519,116.

Controlling Device for Electric Motors, F. E. Herdman, Indianapolis, Ind., 519,123. Filed Oct. 20, 1892.

Similar in its object to No. 519,116.

Electric Motor Controlling Apparatus, F. E. Herdman. Indianapolis, Ind., 519,124. Filed Oct. 20, 1892.

Similar in its object to No. 519,116.

Commutator Brush, R. Kersberg, Hohenlimburg, Germany, 519,188. Filed Jan. 8, 1894.

Composed of a cloth of wire spirals screwing into one another.

Electric Motor, E. E. Ries and G. J. Scott, Baltimore, Md., 519,272. Filed July 27, 1893.

Consists of several groups of sectional, laminated, and interlaced field magnets circularly arranged, a concentric sectional laminated armature, circuit connections, and a commutator,

Electric Generator, W. Baxter, Jr., 519,280. Filed May 12, 1891.

Claim 4 follows :

The combination of the frame, the field magnets mounted on the frame, the shaft fixed rotatably in the frame, the armature and commutator mounted on the shaft, the sleeve between the armature and commutator and the nut on the shaft, impinging against the commutator, whereby said armature and commutator are secured.

Electric Motor or Generator, W. Baxter, Jr., 519,281. Filed May 12, 1891.

Relates to certain mechanical details of construction and more especially to the commutator and brushes.

Heating :—

Electric Heater, S. B. Jenkins, Boston, Mass., 518,018. Filed March 31, 1893.

Lamps and Appurtenances :—

Electric Arc Lamp, J. B. McKeown, Cleveland, O., 519,045. Filed Feb. 28, 1824.

Relates especially to the mechanism for feeding and controlling the carbon rods.

Incandescent Electric Lamp, F. S. Smith, Pittsburgh, Pa., 519,099. Filed Nov. 29, 1892.

The invention consists in employing for the stopper a form of glass having a co-efficient of expansion substantially equal to that of iron, of which the leading-in wires are composed.

Electric Arc Lamp, J. C. Fyfe, Chicago, Ill., 519,268. Filed Dec. 29, 1893.

Relates to the feeding mechanism of arc lamps using disc carbons.

Miscellaneous :—

Electric Elevator, F. E. Herdman, Indianapolis, Ind., 519,117. Filed Oct. 20, 1892.

Means for Introducing Insulating Material Into Conduits, D. Brooks, Jr., Philadelphia, Pa., 519,171. Filed Nov. 23, 1892.

Railways and Appliances :—

Electric Conductor for Underground Conduits, D. E. Conner, Covington, Ky., 518,939. Filed Jan. 23, 1893.

Claim 9 follows :

In combination with a conductor a contact chain composed of pieces or links having a continuous wire or rod at their lower edges and means for loosely supporting said links below the conductor.

Trolley for Electric Railways, G. W. Hooper, Rochester, 518,958. Filed June 1, 1893.

Relates to certain mechanical details of the trolley and yoke.

Electric Railway Conductor Support, J. C. Henry, Westfield, N. J., 519,115. Filed Sept. 27, 1889.

Employs two working conductors, one being divided and the other yieldingly supported normally above the point of division so as to pass through the division on the passage of the trolley.

Electric Railway, W. B. Purvis, Philadelphia, Pa., 519,291. Filed Apl. 14, 1893.

Employs a magnetizable conductor within a closed conduit the upper portion of which is uninsulated, and magnetic means for raising the conductor into contact with the uninsulated portion of the conduit as the car passes.

Telegraphs :—

Relay, H. S. L. Verley, Hoboken, N. J., 519,142. Filed Jan. 13, 1894.

The invention consists in combining with the relay an auxiliary electromagnet in circuit with the primary magnet and adapted to act on the contact arm simultaneously with the primary magnet.

Telephones and Apparatus :—

Telephone, E. V. Kolbassieff, Cronstadt, Russia, 518,959. Filed Sept. 21, 1893.

A transmitter and receiver especially adapted for use in divers' helmets.

LEGAL NOTES.

THE INJUNCTION AGAINST THE OCONTO CO. SUSTAINED.—EDISON ELECTRIC LIGHT CO. vs. ELECTRIC MFG. CO.

THE appeal of the Electric Manufacturing Co. of Oconto, Wis., *vs.* The Edison Electric Light Co. (General Electric Co.) from the decision of the U. S. Circuit Court, which granted the Edison Co. an injunction *pendente lite*, came up before the U. S. Circuit Court of Appeals, which has just rendered a decision sustaining the decision of the court below, which thus enjoins the Oconto Co. from manufacturing incandescent lamps until final hearing.

In the opinion which is written by Judge Jenkins, the court holds with Judge Colt, in the Beacon case, that where the validity of a patent has been sustained by prior adjudication, and especially after a long, arduous and expensive litigation, the only question open upon motion for a preliminary injunction in a subsequent suit against another defendant, is the question of infringement, the consideration of other defenses being postponed until final hearing ; the only exception to the rule being where the new evidence is of such a conclusive character that, if it had been introduced in the former case, it probably would have led to a different conclusion.

The court then discusses the alleged anticipation of Goebel and the evidence submitted to sustain the claim. The conclusions reached by the court are, that without assuming the story of Goebel's invention to be untrue, it is surrounded by such an atmosphere of improbability that until it is thoroughly sifted and sustained upon final hearing, the claim ought not to be allowed to stand in the way of a patent which has already safely passed the ordeal of judicial scrutiny.

THE FIELD ELECTRIC RAILWAY PATENT DECLARED INVALID. ELEC. RY. CO. OF U. S. vs. JAMAICA & BROOKLYN RY. CO.

On May 3 Judge Townsend of the U. S. Circuit Court for the Eastern District of New York rendered a decision in the case of The Electric Railway Co. of the United States against the Jamaica and Brooklyn Railway Co., in favor of the defendants. This suit was brought under the famous patent granted to Stephen D. Field, July 16, 1889, No. 407,188, the principal claim of which reads as follows :

> The combination of a stationary dynamo electric generator driven by a suitable motor, a circuit of conductors composed in part of an insulated or detached section of the line of rails of a railroad track, a wheeled vehicle moving upon and along said insulated section of track, an electromagnetic motor mounted upon said vehicle for propelling the same and included in said circuit of conductors, and a circuit controlling device placed upon said vehicle.

Judge Townsend holds that the evidence shows that the elements of the combination were not new to the art and that they were embodied in a prior patent issued to Clark.

The suit was defended by the General Electric Co.

ANOTHER REFUSAL TO ENJOIN THE BUCKEYE ELECTRIC CO.

Word reaches us from Cleveland as we go to press that Judge Ricks has again refused the motion of the General Electric Co. to enjoin the Buckeye Electric Co., for incandescent lamp infringement.

M. S. SHAPLEIGH has brought suit before Judge Dallas in the U. S. Circuit Court at Philadelphia against the Chester Electric Light and Power Co. for infringement in the use of cut-outs similar to those made under his patents by the Emerson Electric Mfg. Co. of St. Louis.

MR. W. S. HADAWAY, JR., is to lecture before the New York Electrical Society at Columbia College, on May 10, on some features of electric heating. The lecture promises to be one of the most interesting of a very successful season.

ON the evening of May 4, Mr. Alexander Jay Wurts, of the Westinghouse Co., delivered a lecture at Columbia College before the electrical engineering students on the subject of "Non-Arcing Lightning Arresters." Mr. Wurts explained the theory of his now well known zinc cylinder arrester and showed a new type of apparatus intended for street railway circuits. The lecture was illustrated by a number of striking experiments and the arresters were shown in operation. Mr. Wurts also delivered the same lecture before the Boston Society of Arts, on April 30.

Trade Notes and Novelties

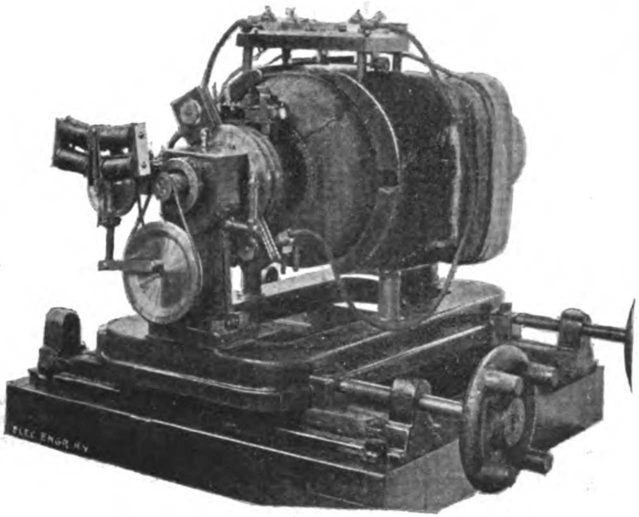
AND MECHANICAL DEPARTMENT.

THE BAIN ARC MACHINE WITH AUTOMATIC REGULATOR.

THE accompanying illustration represents a constant current arc light dynamo with regulator, the invention of Mr. Forée Bain, and now being manufactured by the Great Western Manufacturing Co., of Chicago.

As will be seen, the field is of the salient pole, horse-shoe type, cast in one piece. The armature is large in diameter and is very strongly built; it is of the Gramme type, having a large number of independent coils, by means of which a very steady current is produced. The brushes are of carbon and are so placed as to produce a constant lap on the commutator.

The automatic regulation is performed by the movement of the brushes around the commutator. The motor device employed for the movement of the brushes is operated by means of a small belt connecting the armature shaft to a larger pulley, as shown in the engraving; by the rotation of this large pulley the ratchet bar is reciprocated. The ratchet bar carries a small ratchet, which is held out of engagement with the ratchet wheel by means of two elliptical springs on either side of the armature, placed between two pairs of electromagnets. The ratchet wheel is connected by means of a shaft, not shown in the engraving, to a small pinion which engages with gearing cut on the rocker arm which carries the brushes.



THE BAIN ARC MACHINE WITH AUTOMATIC REGULATOR.

The "directing" device, shown under the connecting board, which is mounted on top of the dynamo, consists of a small iron bar suspended immediately over the armature. This "director" controls two contact devices, shown on the top of the connecting board, which operate to short circuit both electromagnets when the machine is working under normal conditions and is producing a current at which it has been adjusted. The thumb nut, on the right hand side of the engraving and just below the connecting board, illustrates a means of adjusting the strength of the current while the machine is in operation; this thumb nut is connected by means of a bar and a spiral spring to the director bar, and tends to hold it in a position opposite to the position that the bar would assume by an increase of current in the armature. The operation of the device is as follows:

When the machine is first started the spring connected to the controller pulls the controller bar into position approximately parallel with the path of the current circulating in the wires of the armature. When the current in the armature has assumed a given value, which has been predetermined by the tension of the spring, the deflecting bar is deflected from a line parallel with the current in the armature to a line slightly at an angle therewith. Before it has been deflected, however, to the position described, the contact above the deflecting bar has been opened by the deflecting bar being out of position it later assumes. When the machine is operating under normal conditions, an open contact above allows the current to pass through a pair of electromagnets on the right hand side of the armature, situated between the two pairs of electromagnets. The current circulating in this pair of electromagnets attracts the armature toward them and engages the ratchet device in the ratchet wheel and quickly gigs the ratchet wheel, in this case, in clockwise direction, which moves the brushes to a point on the commutator corresponding to the highest potential.

If the external resistance is such that the current may be maintained with a lower voltage than the maximum of the dynamo, the current tends to rise above its normal value and the director is deflected to a still greater angle, which causes the contact controlling the electromagnets on the left hand side of the electromagnetic armature to be closed; and at the same time, the contacts controlling the electromagnets on the left hand side of the armature are opened, allowing the current to pass through them, and they attract the armature, which causes the double ratchet to engage in the ratchet wheel in such a way as to cause it to move in an opposite direction from that just described; by this means the brushes are moved forward on the commutator to a point where the E. M. F. is just sufficient to maintain a constant current through the resistance contained in the circuit.

When the machine is operated through a circuit which remains substantially unchanged the brushes remain quiet and the only moving device is the crank wheel and the reciprocating bar, which holds the ratchet since the ratchet is held out of engagement until one or other pair of the electromagnets are energized. The director device may be adjusted at any time while the machine is operating so that it will maintain a constant current at any value desired within a range of 20 per cent. of its rated capacity, that is to say, it may be adjusted to deliver a current 20 per cent. larger or 20 per cent. smaller than the rated capacity of the machine.

The regulator is said to be very sensitive and at the same time very positive in operation, and to maintain a constant current independent of the number of lamps in circuit. The machine may be run indefinitely on an absolute short circuit without injurious results.

The machine is very substantially constructed, has self oiling bearings, and is self contained, no outside device being necessary.

MR. GIDDINGS AND THE BROWNELL & CO.

MR. C. M. GIDDINGS, who has been for the past six years in charge of the Sioux City Engine Works, has recently connected himself with The Brownell & Company, of Dayton, Ohio, manufacturers of boilers and engines. They have bought the exclusive right to manufacture under his patents, and have established a department of engineering under his supervision. The Brownell & Company will make a specialty of high grade automatic engines, both simple and compound, and have purchased the entire stock of drawings, patterns, finished and unfinished automatic engines of the Sioux City Engine Works. These engines are well known in the trade as the Russell single valve automatic. Mr. Giddings was in charge of their engineering department for four of the seven years he was with them, and while there designed and patented his governor and valve. The highest grade of workmanship and finish will be maintained in these engines, which have already obtained a high standing for their close regulation. The Brownell & Company have superior facilities in their boiler manufacturing department, and have recently added to their boiler shop equipment a set of 20 foot rolls, 18 inches in diameter, capable of rolling the heaviest plate and making 20 foot boilers in two sheets.

A COMPACT WESTINGHOUSE PLANT IN PITTSBURGH, PA.

AN electric generating plant has lately been installed in the new building of Heeren Brothers & Co., Pittsburgh, Pa., the installation being very compact and complete throughout for one of its size.

The outfit comprises two "Kodaks," consisting of two 10-18x10 Westinghouse compound engines and two Westinghouse 56 K. W. multipolar generators, coupled direct to each other with the well known Westinghouse flexible couplings. The engines and generators run at a speed of 320 R. P. M. The switch board is made with the main portion across the end of the room, with an angle at one side. This construction became necessary on account of the limited space; the main switches and all instruments are on the angle portion and all circuit switches, cut-outs, etc., are on the main body of the board. The board is of hard wood with all instrument mountings of marble. The whole installation is artistically and finely finished, and is considered the finest plant of its size yet installed in this section. When in operation the engines and generators are absolutely noiseless, due to the absence of belts. The space occupied by the two "Kodaks" and angle switch board is only 16′ by 19′, with ample space around and between each rig for handy operation of both dynamos, engines and switchboard apparatus.

It was found necessary when constructing one of the foundations to bridge over a building support footing, which was done by the use of heavy I beams carried across over this footing. This construction has proved very satisfactory, as there is no vibration felt in the building when either or both of the "Kodaks" are in operation.

The installation was made by the Westinghouse Electric & Manufacturing Co., and Westinghouse, Church, Kerr & Co.

ELECTRICAL APPARATUS AND STEAM ENGINE PLANT WANTED BY THE WEST VIRGINIA UNIVERSITY.

The West Virginia University is building a Mechanical Laboratory adjacent to the Mechanical Shops, in which the light, heat and power plant of the University will be installed. Having this plant all under the same roof in the Department of Mechanical Engineering greatly increases the facilities for instruction, as the whole plant will be available at any time for experimental work and special testing and investigation.

The equipment will include a storage battery plant, arc and incandescent dynamos and motors, electrical testing and measuring instruments, simple and compound engines, installed so as to work as a triple expansion engine of 100 H. P.; exhaust steam and independent jet and surface condensers, compound pumping engines for reservoir service and duty tests; high pressure sectional boilers, set for coal and natural gas firing; and the present equipment of standard engineering testing and measuring instruments and accessories will be materially increased.

The University is located at Morgantown, West Virginia, on the Monongahela River, and on the new link of the Baltimore & Ohio R. R., connecting the Pittsburgh and Wheeling lines.

The University is ready to receive bids and estimates on all the above apparatus, which may be addressed to Prof. Wm. S. Aldrich, Director of the Department of Mechanic Arts.

HARRY S. SMITH & CO., LTD.

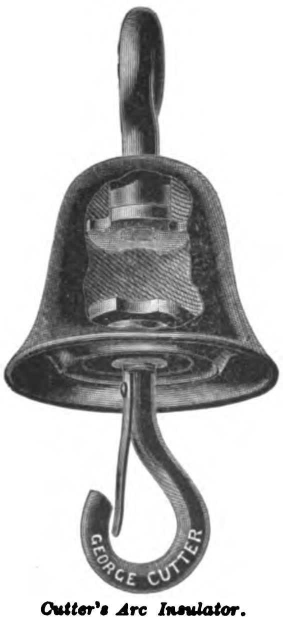
About this season of the year the wise man begins to bethink him of the discomfort of the hot summer days and nights, and to provide for the future. The first thing to do, of course, is to buy an electric fan for each room or office, and have it ready to turn on as soon as it is needed. To lessen the burden of choosing the style or make most suitable to each case, Messrs. Harry S. Smith & Co., Ltd., of 607 Chestnut street, Philadelphia, have issued a twelve page catalogue presenting several types of fans and fan motors for both direct and alternating currents, for which they have the agency. Among these are the Crocker-Wheeler and Ries & Scott fan motors in various styles, and the Smith and La Rue ventilating fans.

On the last page of the catalogue also appears a well executed and life-like illustration of the Colvin desk telephone set, manufactured by the Interior Telephone Company of 203 Broadway, New York, and for which Harry S. Smith & Co. are the Philadelphia agents.

THE NEW BRUSH STATION, BALTIMORE, MD.

The new electric light and power station for the Brush Electric Light Co., of Baltimore, Md., will be one of the finest in the Southern states. The boiler room is 83 ft. wide by 129 ft. long. The dynamo room is 130 ft. square,—the floor space in the latter being entirely free from posts. The roofs are designed and built by the Berlin Iron Bridge Co., of East Berlin, Conn., and are made entirely of iron, covered with their patent anti-condensation corrugated iron roof covering.

CUTTER'S ARC INSULATOR.



Cutter's Arc Insulator.

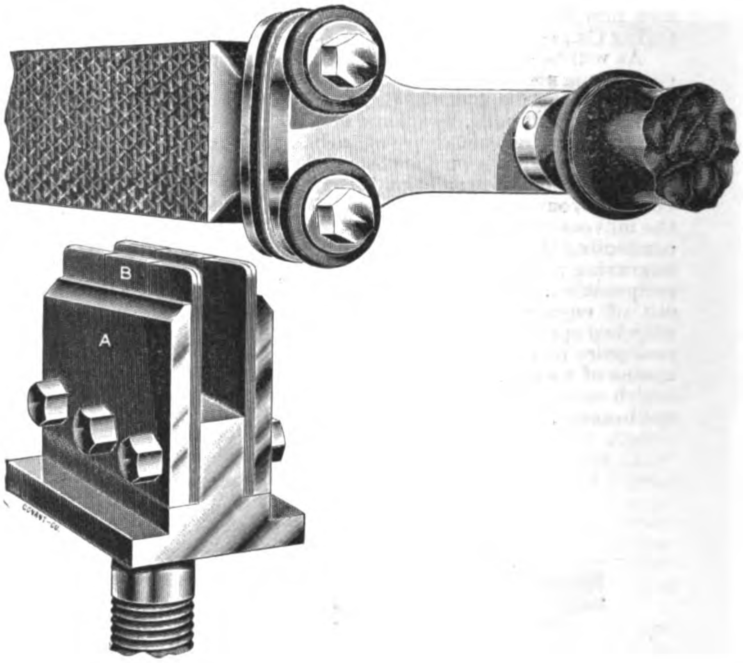
Most arc lamp users have felt the need of a good device for insulating the frame of the lamps from the hoisting rope or the supporting arm, so as to reduce the chances for grounds in wet weather. Many of the existing arc insulators and break insulators are readily covered with a film of moisture on rainy days, and therefore George Cutter, of Chicago, has devised a new form which seems to avoid this source of trouble. Our illustration shows the new type which is only twice the size of the cut. The insulator proper is made of hard rubber which is less likely than glass to have a film of moisture form on its surface. The double petticoat gives a good water drip, so that the moisture cannot readily creep across the lower surface. All parts are designed for ample strength, the eye at the top and the snap-hook at the bottom being threaded into bushings which are moulded directly into the rubber. The whole device seems well suited to the needs of the case and Mr. Cutter is already finding a good market for it.

THE LATEST HILL SWITCHES.

We herewith illustrate one of the latest improvements in the switch line by the W. S. Hill Electric Co., a patent for which has just been issued bearing the date of April 24, 1894.

The first feature in the invention is the manner in which the two or more blades are secured to the yoke so as to obtain rigidity and keep all of the blades in proper alignment while the switch is being operated.

By the old method of securing the blades to the yoke (to which the handle is attached) by a single bolt or screw in each blade, there was nothing to prevent the twisting of the blades, thus allowing one to move in advance of the other, and as the two or more poles would not break in unison, excessive flashing would result.



The New Hill Switch.

To overcome this defect and produce a more mechanical and substantial device, the outer ends of the blades and yoke have been broadened, and two screws or bolts inserted, thus securing the parts so rigidly that the blades must at all times move in unison, and all the blades leave the contacts at the same instant.

The second feature consists in backing up the regular flexible contacts B, by what they term "reinforcing plates," A. It has heretofore been the custom to use nothing but the copper strips B, and these of necessity being flexible were liable to spring apart by constant usage, thus impairing the contact and causing the parts to heat. By the method shown the flexibility is maintained, and on account of the reinforcing plates the flexible contacts are always held in proper position, consequently the electrical connection between blade and contact is always kept perfect.

It will also be seen that the carrying capacity of the flexible copper plates B, is increased by the reinforcing plate A, to the maximum of any other part of the circuit, preventing loss of current in the switch and heating and destruction of its contacts. Hundreds of these switches are now in use, and the value of the inventions embodied in them are becoming more and more apparent as the test of time is applied.

THE MATHER ELECTRIC COMPANY.

The Mather Electric Company report the following sales of apparatus outside of their railway business during ten consecutive days recently:—Mass. Hospital for the Insane, Northampton, Mass., one 350 light and one 600 light dynamo; Eastern Yacht Club, Boston, Mass., one 250 light dynamo; Wayne County House, Wayne, Mich., two 20 K. W. direct connected dynamos; S. N. Blake, Elmira, N. Y., one 350 light dynamo; Sherman & Kopf, Detroit, Mich., one 250 light dynamo; George Whitney Woolen Co., South Royalston, Mass., one 100 light dynamo; Syracuse *Herald*, Syracuse, N. Y., one 250 light dynamo; Union Central Life Insurance Building, Buffalo, N. Y., one 450 light and one 250 light dynamo; Patent Cereal Company, Geneva, N. Y., one 150 light dynamo; Crane Bros., Westfield, Mass., one 50 light dynamo; Henry Reinhardt, New York City, one 150 light dynamo; Boston Ferrule Company, East Boston, Mass., one 50 h. p. slow speed motor; Phelps Publishing Company, Springfield, Mass., one 50 h. p. slow speed motor; in Springfield two 15 h. p. and one 1 h. p. motors, and 16 other motors, from 1 to 15 h. p., in various places.

AN ELECTRICAL ADVERTISING WAGON.

The accompanying illustration, Fig. 1, shows the electrically lighted advertising wagon of Keith's Union Square Theatre, New York. Its equipment consists of 32 chloride accumulators of type E, 9 plates, 200 ampere hours capacity, furnished by the Electric Storage Battery Company, of Philadelphia. The cells, shown in Fig. 2, are in four boxes, eight to the box, each box weighing, complete, about 400 lbs. Sixteen cells compose a set, which is in use on the wagon while the remaining set is being charged.

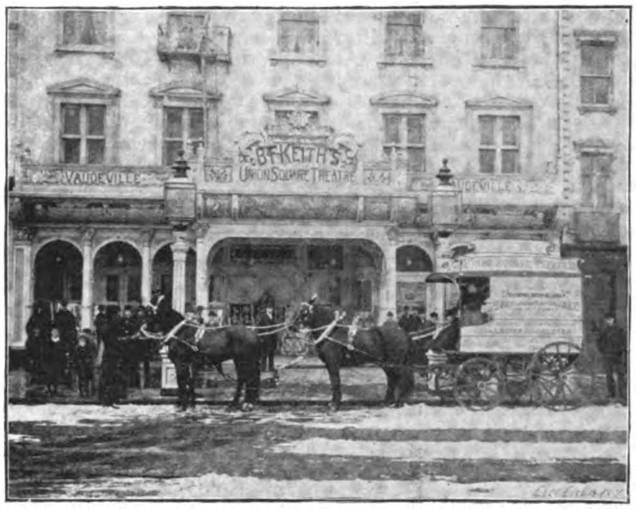


Fig. 1.—Keith's Electric Show Wagon.

The wagon is wired with extra heavy rubber-covered No. 12 wire and a No. 14 specially made black silk cord runs from the wagon to the horses. The wagon carries fifteen 28 volt 16 c. p. DeKhotinsky lamps in Edison sockets, and each of the four horses carries two 30 volt 16 c. p. lamps of the same make in Swan sockets which are fastened between the ears and on the saddle. Bryant switches control the four circuits, two on the wagon and one each on the leaders and wheelers. The batteries are charged from the theatre plant in a small house built for the purpose in the rear of the main building.

This outfit has been in charge of Mr. R. Burbank, electrician of the theatre, and has been running very satisfactorily since it was brought out in September, 1893. The wagon has been used in Boston, Providence, Philadelphia, Brooklyn, and New York, and has made extended trips through the suburbs of these cities. As an advertising novelty, it has been a great success and never fails to attract admiring attention.

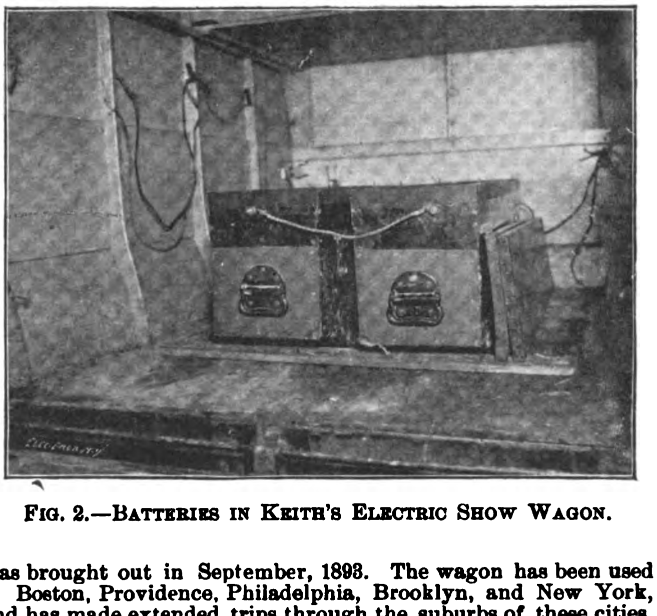


Fig. 2.—Batteries in Keith's Electric Show Wagon.

Mr. D. A. Starr, well known from his long connection with the Royal Electric Co., of Montreal, Canada, has severed his direct connection with that company. He has temporarily opened an office in the Board of Trade Building, Montreal, and has the best wishes of numerous friends for his future success.

MICANITE CLOTH.

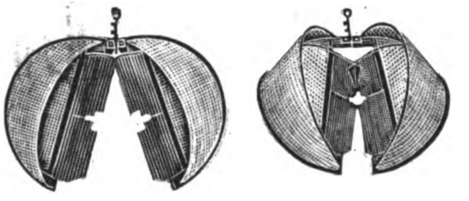
It is always advantageous, in advertising a really good thing, to exhibit the article itself, rather than deplete the gray matter of one's brain thinking up a list of superlatives to adequately describe it. Besides, it is easier, and this is a labor-saving age. It is impracticable, perhaps, in some instances, as it would be annoying, to find one's desk covered each morning with generators, motors and engines sent out as samples by the manufacturers, and it is manifestly impossible in the case of inferior goods.

The Mica Insulator Co., of 218 Water street, is fortunate in manufacturing a material not too cumbersome to be thus advertised and so good that it can be allowed to speak for itself. The company has sent to each of its friends a sample of "Micanite cloth," which for general purposes is a most useful form of insulation. It has recently been greatly improved and is now said to be non-absorbtive, to remain flexible indefinitely and to combine a maximum amount of pure India mica with a minimum of thickness. It is put up in rolls 32 inches wide and 16 feet long, and can, of course, be cut into any shape to suit any conditions. A pair of trousers of this material which we are now wearing have retained their creases perfectly.

THE CHICAGO SPARK ARRESTER.

The Metropolitan Electric Company is introducing a new arc lamp spark arrester, known as the "Chicago" and shown in the accompanying illustration. It is made to fit any system, either single or double carbon lamp. It is fastened by an adjustable clamp to the lamp holder, inside or outside, and is arranged to open out, separating in the centre, so that, once in position, it is permanently fastened, and is easily opened to each side whenever necessary to trim the carbons or change the globe.

The cover is arranged to automatically open and close, as the carbon holder passes downward through two mica plates, which are hinged and balanced, and close immediately after the holder has passed through. While held at an angle during the time that the holder is gradually being lowered by the consumption of the carbons, that is, about an hour, the device is so constructed that a draught is established, which draws the sparks away from the carbons, and the hood of the arrester is so placed that the sparks cannot escape.



The Chicago Spark Arrester.

It is said that experts who have examined the "Chicago" spark arrester pronounce it absolutely the best thing of its kind on the market to-day, and predict its very general use.

THE WHITE ADJUSTABLE LAMP HOLDER.

The adjustable lamp holders for incandescent lamps, manufactured by O. C. White & Co. of Worcescester, Mass., and fully described in their illustrated catalogue, will be found a great convenience in draughting rooms, machine shops, factories, offices and wherever it is necessary or desirable to change the position of the light easily and quickly.

The foundation is a sectional ball and socket joint on a base suited to the required position, either the ceiling, wall, floor, column or corner being available. This joint has received many awards and medals for its originality and value, especially from the Franklin Institute of Philadelphia, and the Mass. Charitable Mechanics' Association of Boston. From the joint runs a tube of firm metal to a swivel joint which carries another metal tube, usually shorter than the first. This joint allows the extension and rotation of both arms in any direction. The conducting wires pay through the short arm, which at its far end carries the lamp (with its shield and shade if wanted) by a third joint which allows the lamp to be inclined at any angle.

The combination of tubes and joints is a close copy of the human arm, with a ball and socket joint at the shoulder, a swivel joint at the elbow, and a wrist joint, and like the human hand the holder can bring its burden into any position within its sweep. Each joint of the mechanism has an elastic pressure, easily adjusted, which is enough to hold a heavy lamp and shade quite firmly, and still will yield to a moderate force when it is desired to change its position. All the working parts are of metal, made interchangeable; insulating bushings protect the conducting cords, and ample provision is made for any possible wear by prolonged use.

WESTERN NOTES.

Aurora, Ill.—The Brush Electric Light & Power Company has been dissolved and its charter surrendered.

The Glencoe Electric Co. at Chicago was incorporated on April 23d, Jno. I. Flanning, Sylvan Newhall and J. J. Flanders. Capital stock is $3,000.

The Ansonia Electric Co., Chicago.—Mr. J. B. Waller, the assignee, has concluded to continue the closing out sale of the above company for another month, fixing June 1st as the day of closing up the business.

Mr. F. P. Little, of F. P. Little & Co., Buffalo, was in Chicago recently looking after some business matters. Mr. Little reports a very gratifying increase in their supply business and a number of important orders for their alternating arc lamps.

Mr. Willard E. Wermer, secretary of the Westport & Waldo Railway Company, of Kansas City, Mo., writes that his company is in the market for 300 tons of girder rail and an equal amount of T-rail of from 50 to 52 pounds.

Valparaiso, Ind.—The city has granted a twenty-five years' franchise for an electric light plant to E. C. Noe, of Chicago and E. S. Tice, of Crown Point. The city will get forty incandescent lights free of charge. The plant will be in operation within six months.

The D'Unger Long Distance Telephone Co., Chicago, announces that it is now prepared to equip telephone exchanges with the D'Unger telephone appliances. Dr. D'Unger, the inventor, states that this company will furnish telephones for exchange purposes on a small royalty, in consideration of which their licensees will be protected against any patent litigation.

The Chicago Edison Co. and the city have recently had some controversy in regard to the repairing of pavements in bad order from having been torn up by the Edison Co. and others, the city refusing to issue any more permits for excavating in the streets until all defective pavements had been repaired. The Edison Co., finding its business jeopardized by the possibility of not getting any more permits, thereby being prevented from making necessary repairs to its lines, agreed to pay its portion of the expense and has sent a check for its share of repairing Fifth Ave. and Adams St.

The Electric Appliance Company are meeting with great success in the introduction of the Packard Mogul Lamp in all the western territory and particularly in Chicago, where it has already, it is said, displaced arc lamps in a great many places and bids fair to do so in a great many more. While the Packard Mogul was originally intended principally for interior lighting it seems to have also met with considerable favor for outdoor work and is being thus used very successfully by a number of very prominent stations. The Electric Appliance Company have been busy during the past few weeks taking possession of a largely increased floor space and extending their facilities for receiving and shipping goods; particular attention being given to arrangements for the better handling of material in carload lots.

Jas. I. Ayer & Co., St. Louis, report that they have met with quite flattering success in their engineering business since the concern was established, the first of the year. At present they have on hand the reconstruction of the Citizens Electric Light & Power Co., East St. Louis, the erection of the electric lighting plant for the Mercantile Club, St. Louis, also for J. L. Hudson's large new clothing house in St. Louis, the overhauling of the plant of the Pastime Athletic Club, St. Louis, and are just completing a report of the plants of the Metropolitan Electric Railway and the Springfield Electric Light Company at Springfield, Mo. This in addition to being consulting engineers for the Merchants' Exchange of St. Louis, and for the lighting plant of B. F. Stevens, Spirit Lake, Iowa, indicates a fair activity in business in St. Louis.

The Trolley in Chicago. Electric Street Railway matters are still in a somewhat unsettled condition in this city. While the council committee reported in favor of an underground trolley system for the south side, the city council at its meeting on April 23, by a vote of 48 to 18, passed the ordinances authorizing the West Chicago St. Ry. Co. and the North Chicago St. Ry. Co. to operate their lines by overhead trolley wires. The ordinance had several amendments tacked on to it, one by which the overhead trolley is prohibited in the district bounded by the river on the north, the south branch on the west and Twelfth street on the south, also on any of their present cable lines. A new section was introduced and adopted compelling the street railway companies to furnish and maintain arc lights on every second post they may erect, (or at a distance of every 200 feet) within a radius of one mile from the city hall. It is stated upon reliable authority that these ordinances in their present form, will not be approved by the mayor, but from the solid two-thirds vote by which they were passed it is safe to assume that they will again be passed over the mayor's veto.

The National Electric Co., Eau Claire, Wis., have moved their Chicago office to the new Old Colony Building and are now nicely settled in their new quarters. Messrs. Horne & Martin, their general agents have just secured the contract for the incandescent generators for the new Medinah Temple, Chicago. The equipment includes one 450 light and one 1,000 light machine.

PHILADELPHIA NOTES.

Siemens Dynamometers.—Owing to the rapidly growing amount of alternate current working, the demand for instruments to measure the strength of alternating currents has increased enormously in the near past. Although there have been many improvements in the measurements of voltage and power, no radical changes have been found necessary since the invention by Siemens of the dynamometer which bears his name. It remains standard, and with the exception the Thomson balance, perhaps the only reliable instrument for the measurements of alternating current strength. Many minor improvements have been made upon the instrument, chiefly in the laboratory of Queen & Co., Philadelphia, who are the sole American manufacturers.

NEW ENGLAND NOTES.

Mr. George H. Howard, recently with the General Electric Co., has severed his connection with that company, and is now with the Royal Arc Electric Co. of New York City.

The Pettingell-Andrews Co. of Boston, are making rapid progress with their handsome new store on Federal street, and expect to be able to move in in a week or ten days. When completed this will be one of the handsomest electric supply stores in the country, and will be well worth a visit.

The Day-Moberg Electric Co., of Boston, have recently got out an interesting little pamphlet descriptive of their Jupiter Storage Battery, which is having a good sale for lamps where only a little light is desirable. It is peculiarly adapted for portable work, and can be used in a large variety of light work.

The Lynn Manufacturing Co., who have recently taken office room at 620 Atlantic avenue, Boston, are having good success with their new Sinew insulating material, for all classes of electric railway work. Sinew insulation is extremely hard, tough and durable and peculiarly adapted for railway work, where insulators are subjected to heavy strains, and are exposed to all kinds of weather. They have issued a neat catalogue of their manufactures, which railway men would do well to possess a copy of.

Mr. J. Bradford Sargent, the enterprising agent in the East for the Stirling Water tube Boilers, has vacated his old premises the Hathaway Building, and taken a handsome suite of offices on the ground floor of No. 8 Oliver street, Boston. He will there be more central to the steam, mechanical and iron trades, and is now located right amongst the boiler men. The Stirling boiler grows in favor in the East, and Mr. Sargent expects a large business as soon as the times improve, and mills and factories commence to increase their plants.

Wm. L. Walker & Co., have just opened an office at 178 Summer St., Boston, and will do a business in new and second hand electrical apparatus of all kinds. Mr. Walker has been with Frank Ridlon & Co. for several years, and has now determined to go into business for himself. He has been very successful in the past, and now that he has commenced business on his own responsibility, and gathered around him some good salesmen, we look for continued success in the future. Mr. Walker is young in years but has had a large experience in all kinds of electrical apparatus, and will be able to supply anything wanted, either new or second hand.

The W. S. Hill Electric Co., of Boston, still continue to astonish the electrical trade, by being full of work, and up to their eyes in business. They have just shipped a number of handsome switchboards, amongst which is one to the Peninsular Electric Light & Power Co., of Houghton, Mich., one to the Peninsular Electric Engineering Co., of Detroit, Mich., one for the Equitable Building, Boston, and one for the Eastern Yacht Club at Marblehead, Mass. They have recently received another large order for switches, comprising 126-500 ampere switches, and 16-4,000 ampere switches, besides other orders for very large switches, all for 500 volt railroad circuits. The W. S. Hill Co. seem to lead here in this line, and their factory is taxed to the uttermost to keep abreast with their orders, even though they are constantly adding new machinery.

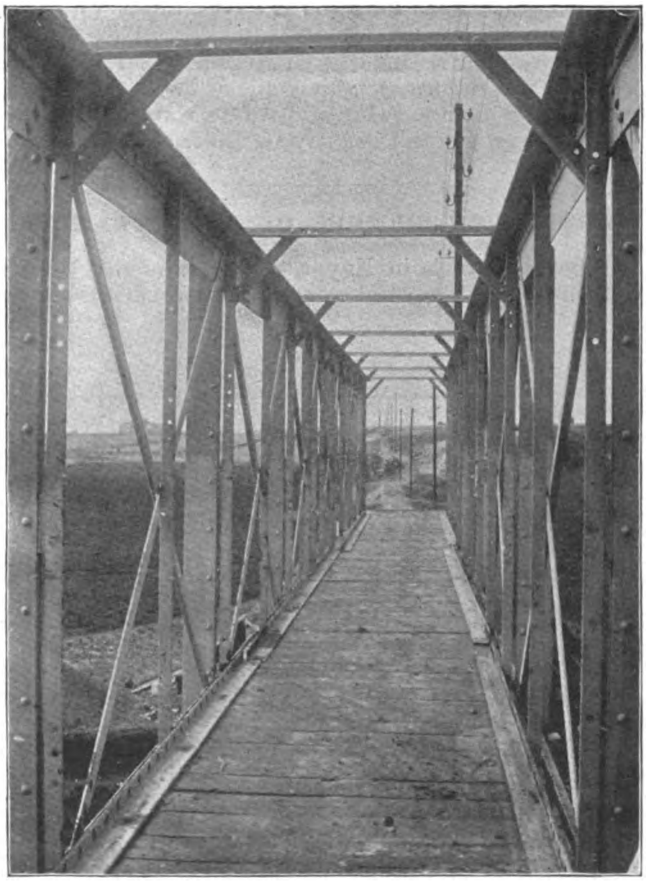
☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. MAY 16, 1894. No. 315.

ELECTRICAL TRANSMISSION OF POWER IN ITALY.

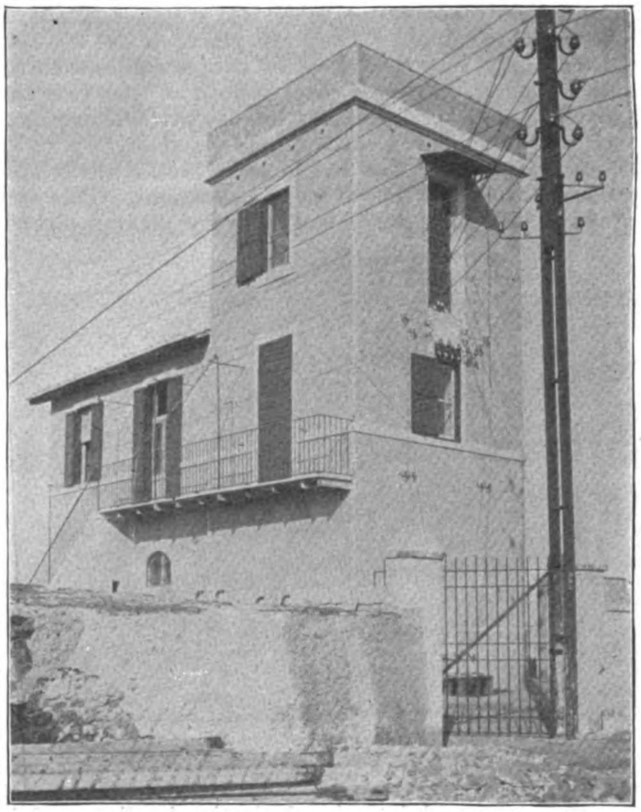
AT the present time when high tension electrical power transmission is a matter of so much discussion and when the question of its commercial practicability is interesting the engineers and financiers of this country so deeply, it is especially interesting to direct attention again to one of the first successful plants of this nature, now in satisfactory operation in Italy, between Tivoli and Rome. Our present article deals more particularly with the important detail of the pole line. As our readers may remember, the generating station installed by Ganz & Co., of Budapest, is situated at the Falls of Tivoli, about eighteen miles from Rome, whence current with a potential of 5,000 volts is carried to the city.[1] In the station are three alternators with exciters arranged as shown in the plan, and driven by nine turbines, in the following manner. There are three complete units each consisting of a generator, driven by two turbines of 330 h. p. each and an exciter driven by a smaller turbine of 50 h. p. The alternators give 42 amperes at 5,100 volts, run at a speed of 170 revolutions a minute, and are coupled in parallel.



Bridge Across the River Arriene for Line Inspection and Repair.

Transformer Station at the Porta Pia.

The regulation proper is effected by means of two Blathy automatic rheostats maintaining the potential constant at Rome, a potential equalizer compensating for the losses in the line.



"Half Way House" for Electrical Measurements and Storage of Apparatus.

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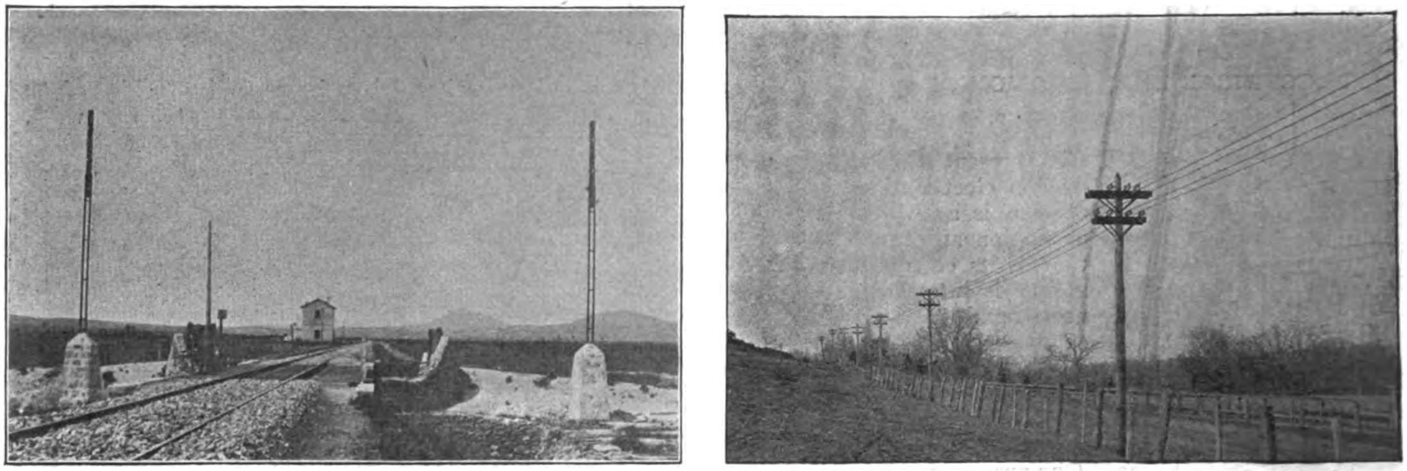
[1] See The Electrical Engineer, Sept. 21, 1892.



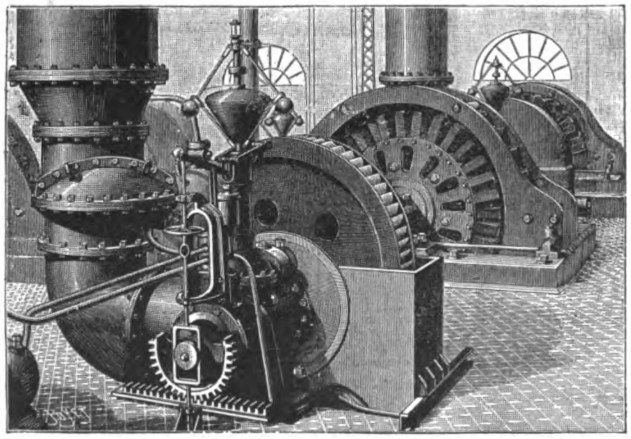
Tivoli-Rome Pole Line.

Baltic-Taftville Pole Line.

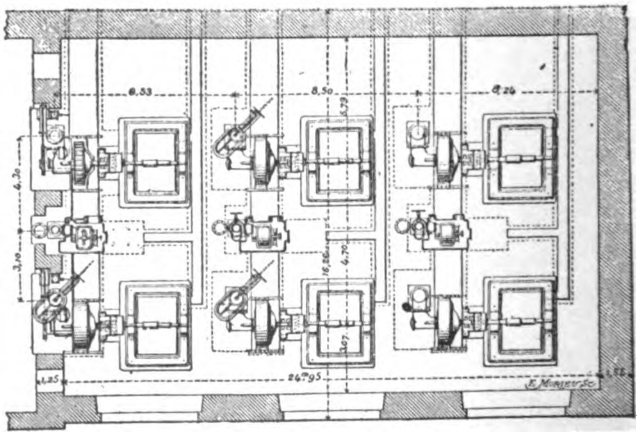
A Comparison of Line Construction.

It is, however, of the line itself that we wish to speak more especially in the present instance, as affording an example of good workmanship that might with advantage be imitated in this country. To show this the more forcibly, we reproduce from our issue of May 2, an engraving of a tri-phase pole line extending from Baltic to Taftville, Connecticut, a distance of not quite four and one-half miles and place it side by side with a view of the eighteen mile Italian line. A critical comparison of the two is interesting. In the former the poles, as will be seen, are of wood, and, while substantial enough for several years of service, cannot compare with the light, yet solid and workmanlike appearance of the strong iron poles made of two T-beams 21 centimetres wide and firmly riveted together, planted in the deserted campagna, and quite capable of lasting until some other system is devised which shall put an end to their usefulness. They are placed about 100 feet apart and carry four twelve strand copper cables each 2.6 mm. in diameter, having a total weight of 100 tons and supported on heavy oil insulators, besides two silicon bronze telegraph or telephone wires 2 mm. in diameter.

About midway between Rome and Tivoli is the "half-way house" shown in one of our illustrations. This was designed to provide a convenient place for making electrical measurements and detecting faults in the line, and is fully equipped with the necessary apparatus for the purpose. Here also are stored extra poles, wires, insulators and tools, as well as the tackle and machinery necessary for erection and repair work. Every facility has been made for the latter all along the line and at no point is any wire, pole or insulator difficult of access. As an instance of this may be mentioned the plan adopted where the River Arriene is crossed, and where a lattice girder bridge has been built, spanning the river, for the sole purpose of carrying the pole line.



Interior of Generating Station.



Plan of Generating Station.

The loss in the line is calculated at about 20 per cent., so that when the substation at the end of the route near the Porta Pia is reached the voltage has been reduced to approximately 4,000. Here it is transformed to 2,000 by 32 converters of 25 kilowatts each, which transmit current to a concentric cable system for general distribution throughout Rome, and also to the arc lighting circuits for street illumination. The transformers for the general distributing circuits have their secondaries so arranged that they may be coupled to produce 500, 1,000 1,500 or 2,000 volts, as circumstances dictate. Our illustrations are made from photographs sent to this country by Prof. Mengarini.

WERNER VON SIEMENS ON THE PYRAMIDS.

During his travels in Egypt, says *Electricité*, Werner von Siemens with several companions ascended the great pyramid and there undertook some experiments in atmospheric electricity. The observations had been going on for some time when the idea entered the minds of the Arabs that it was work of sorcery; their uneasiness increasing, they insisted that the savants should leave the pyramid. Seeing that their objurations produced no effect they undertook to drive them down by force.

"I placed myself then at the highest point of the pyramid" said von Siemens, "and charged my strongest Leyden jar at the moment when the chief of the band was about to seize my hand, to try and pull me from the place that I had chosen. At this critical moment I brought the rod of my condenser within a centimetre of his nose. The effect of the discharge was greater than anything that I could have expected of it. The son of the desert, whose nerves had never been put to such an ordeal, fell backwards as though he had been struck by lightning; but uttering a yell he sprang up and, in an instant, vanished from our vicinity followed by all his companions."

ELECTRICAL SANITATION IN FRANCE WITH THE HERMITE PROCESS.

The successful introduction of the Wolff process of electrical disinfection in connection with the New York water supply has stimulated work abroad, and some experiments made in connection with the recent international Hygienic Exposition at Havre, France, have demonstrated the value of this process, for the disinfection of the waste waters of cities.

At the Havre exhibition, M. Hermite undertook the disinfection of the Saint François quarter, and of seven water closets in the City Hall. For the latter experiment a three h. p engine drove a dynamo connected to the electrolyzer, shown in Fig. 1 (taken from *La Lumiere Electrique*), in which sea water was circulated. The latter, after being transformed into a chlorinated solution was pumped into a reservoir, where it was distributed in the ordinary way by lead pipes in the flush tanks of the closets. The arrangement was such that after leaving the closets the solids and liquids ran into an open runway, so that the visitor at the Exposition has a chance to note its complete deodorization. In these experiments, as well as in those of the St. François quarter, the sea water was electrolized so as to contain from .1 to .05 of a gramme of chlorine per litre. The experiments of Jalan de la Croix having shown that .033 gramme of chlorine per litre was sufficient to sterilize a broth culture.

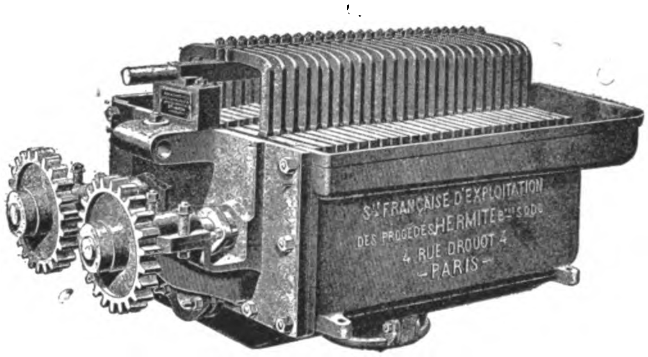

Sté FRANÇAISE D'EXPLOITATION
DES PROCÉDÉS HERMITE Bté S.G.D.G.
4 RUE DROUOT 4
PARIS

FIG. 1.

The electric disinfecting plant of the Saint François quarter was established on the Quai Lamblardie and is shown in Fig. 2. It consisted of two steam engines of 25 h. p. which operated two sets of apparatus for producing the electrolytic solution similar to that used at the City Hall. Each group comprised a dynamo of 1,200 amperes and six to seven volts, the electrolyzer being placed on top with a rotary pump to circulate the sea water. The electrolyzed solution was distributed through lead pipes of more than three kilometres in length, placed in the streets of Saint François quarter. There were 80 outlets for the sprinkling of the gutters and sewers of the quarter. The washing and sprinkling of the streets was effected by means of this liquid and in place of the black mud there appeared a pure sand, notwithstanding that the waste waters were produced by a very compact population of 10,000 people. Two houses, selected as being particularly in an unsanitary condition, were arranged to receive the electrolytic solution in the closets, sinks, etc. The one was provided with a reservoir for the electrolyzed solution, placed on top of the house, and in place of the tubs which existed in the house, closets were substituted with flush tanks, provided with the electrolytic solution. A diffusing syphon received all the liquid which was finally run into the gutter of the street and reached the sewer at some distance. In both houses the disinfection appeared to be perfect. The outlet was also provided in the laundry at the Quai Lamblardie where the washerwomen were able to use the liquid for bleaching their linen.

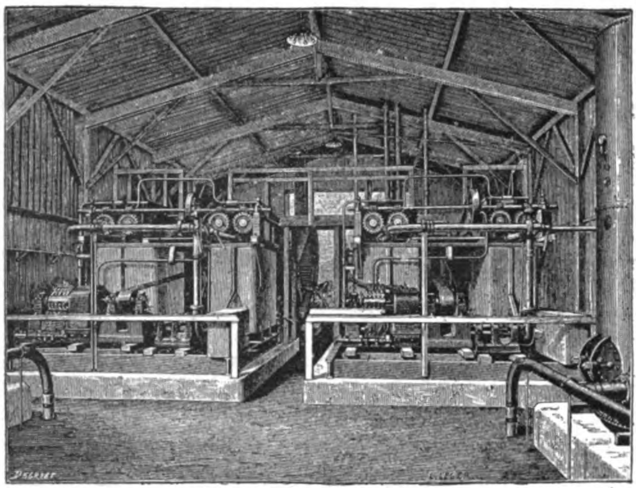


FIG. 2.

The results of the experiments show that where sea water is obtainable, electrical disinfection can be carried out at a cost of about 2 francs per inhabitant. We might add that similar experiments at electrical disinfection have lately been tried at Lorient and Nice, and that an electrolizing plant has also been placed in the building of the *Figaro* newspaper, in Paris.

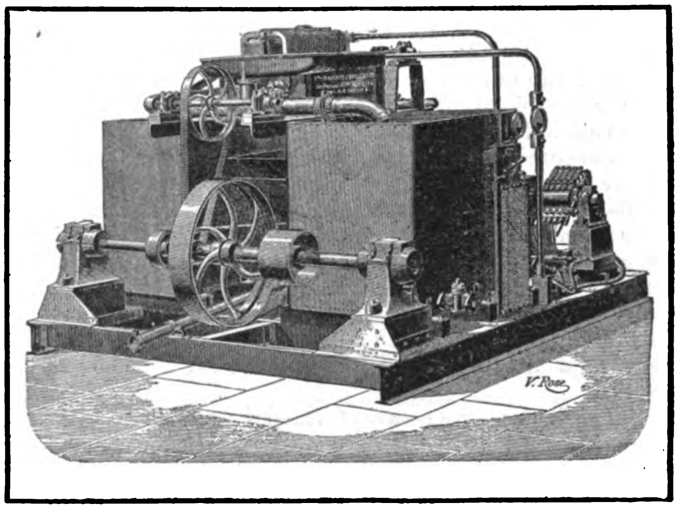


FIG. 3.

THE RIES AND SCOTT ALTERNATING MOTOR.

For some time past Messrs. Ries & Scott, of Baltimore, have been at work perfecting an alternating motor, the announcement of which has already appeared in our columns, but of which details have been withheld up to the present time. The issuance of a patent to these gentlemen last week now permits us to lay before our readers some of the details of construction of the new motor. Our illustration, Fig. 1, shows the machine in longitudinal section, while Fig. 2, shows it in transverse section.

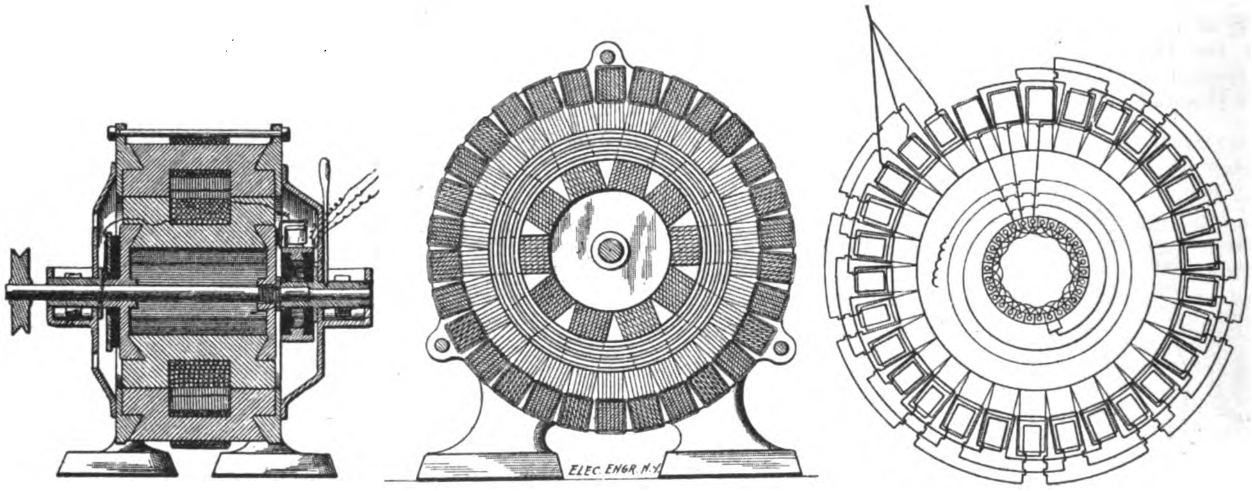
The armature of the motor is composed of a series of laminated cores which extend parallel with the motor shaft and are dovetailed at the ends, being held in position by a non-magnetic head at each end. At their outer circumference these laminated bars are channeled and in this channel is wound a coil, which, when energized converts the laminated bars into a series of magnets, the projections of which at each end are of like polarity.

Surrounding the armature are the field magnets, having a construction similar to that of the armature magnets, there being three times as many field magnets as armature magnets. Owing to the greater number of field magnets the sides of any two consecutive field magnets are very nearly parallel to each other, and so close together that when any two magnets are simultaneously energized by the field current, each will act inductively upon the other. Each field magnet has a separate winding and there are as many commutator bars as there are field magnets. The latter are joined into three groups, as shown in Fig. 3, and the commutator bars belonging to the same group are interconnected. From each group of these commutator bars there extends a wire for connection with the field magnet coils, and from the brush holder a connection is made with one terminal of the armature coil, the other end of which is connected to a collector disc, shown in Fig. 1, mounted on the shaft opposite to that of the commutator end. A spring bears upon this collector disc, which is connected to a binding post; a second binding post is connected with the field magnets, and to these two are attached the line wires.

The field magnets are formed into three groups, the individual coils of which are connected in series. Each of these series has one end connected to a commutator bar while the other ends of the three series are joined together and connected to one of the binding posts above referred to. The commutator brush is of a width equal to that of one commutator bar plus the thickness of the two insulating partition bars so that the brush always bridges two commutator bars. As a result, the current divides at the commutator and passes in two parallel branches through two of the three series groups of field magnet coils. The operation of the motor is evidently the same whatever be the direction of the current.

From the construction it follows that there are always pairs of field magnets directly energized by the current through their coils, separated by single field magnets which are not directly energized by the current. The consequence is that the armature sections are repelled by two consecutive sets of field magnets and attracted by the third set, the attraction and repulsion shifting as the commutator brush passes from one bar to the following. The direction of rotation of the armature depends upon the position of the commutator bar with reference to the field magnets, so that by a very small shift of the commutator the motor may be reversed. There is also a critical position of the commutator at which the motor stops; in virtue of this peculiarity the motor can be stopped and reversed without breaking the circuit.

According to the inventors, the motor permits the passing of a much greater amount of current than has heretofore been possible in alternators, so that it can develop increased power for the same size. As a result of the construction also, by which the magnetism between the opposing field and armature poles is under a continual state of opposing internal stress, it is claimed that the loss from hysteresis is practically eliminated, so that the frequency of alternation may be almost disregarded.



Figs. 1, 2 and 3.—Ries and Scott Alternating Motor.

A TRANSMISSION DYNAMOMETER.

BY

Louis Duncan.

The transmission dynamometer described below has been found useful for some special experiments for a number of years. I have used an absorption dynamometer consisting of a copper disc rotating in a magnetic field. The power was calculated from the pull on the magnet, and the speed of the disc. The heat was absorbed by water running through the apparatus. This dynamometer is of a rather limited range unless belting is resorted to.

For the purpose of trying some experiments on the efficiency of air propellers, a transmission dynamometer was designed on somewhat the same principle. It consisted of a copper disc fastened to the propeller to be rotated, and placed in the field of a rotating electromagnet. The apparatus was calibrated by turning the magnet at known speeds, and measuring the pull of the disc, which was kept stationary. After this, to measure the power transmitted, it is simply necessary to know the speeds of the field magnets, and the copper disc, and the pull is proportional to the difference of the speeds, and can be obtained from the calibration curve. The disc is so constructed that it can be cooled by allowing water to flow on it in such a manner as not to absorb power, and a temperature correction can be applied if necessary.

The speed of the disc can be regulated by varying the speed of the magnets, and the strength of the magnetic field. In this way power can be transmitted without the intervention of any belt or gearing, and it forms an exceedingly convenient apparatus for some purposes.

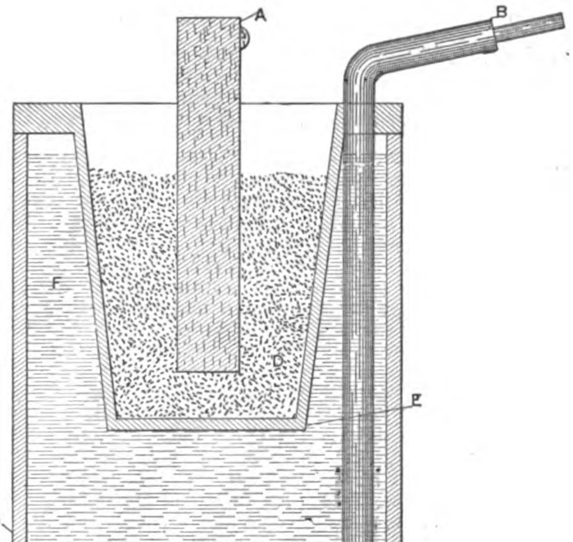
THE HENRY ACCUMULATOR.

Among the many inventors devoting themselves to the perfection of the storage battery is Mr. G. B. Henry, of Hartford, Conn., who has recently devised the form of cell shown in the accompanying illustration, and which possesses some novel characteristics for which special advantages are claimed.

In the illustration, which represents a section of the cell, C is the lower carbon plate, containing a spongy mass of carbon, H. The active material, D, is composed of concentrated suboxide of lead, and is contained in the porous pot, E. The electrolyte, F, is made up of a gelatinous mass of flax seed produced by boiling the seed in water to a proper consistency and then allowing it to cool and stiffen and adding dilute sulphuric acid. A is the carbon lead for the active plate, and B the rubber covered lead for the lower carbon plate.

The lower or active plate is prepared by taking oxide of lead, and subjecting it to the action of equal parts of concentrated nitric and hydrochloric acids. Chloride of lead is precipitated, which is then subjected to a temperature of about 300° Fah. when a suboxide is produced in a chemically pure state. This is pulverized when cold and sifted over the carbon plate at the bottom of the cell.

In preparing the coating of the active plate, one part by weight of red lead is used to ⅛th part each of concentrated hydrochloric and nitric acid. The plate is said to be of great efficiency and practically indestructible. The action of the charging current on the active material that is in the form of a sub-oxide solidifies the lead and changes it to a black oxide. This causes the plate to operate as an active plate of the cell on discharging. On discharging, the sulphuric acid acting on the oxide of the active plate changes the oxide back to its natural state and generates a current.



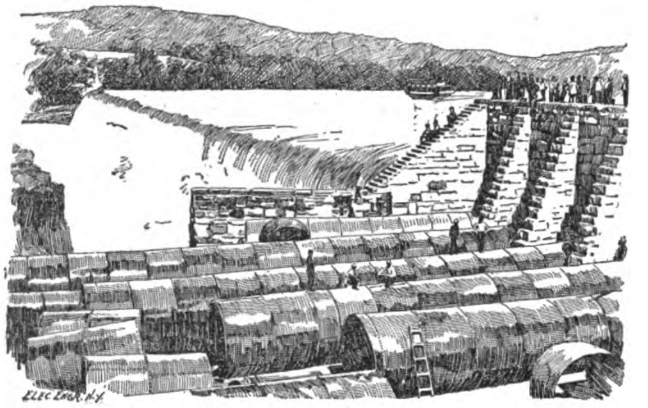
Henry Accumulator.

The advantages claimed for this construction of cell reside in the lessening of the weight in the use of the carbon plates, in the freedom from buckling and consequent prevention of any increase in the resistance within the cell by such buckling; in the greater capacity of the plates and increase of electromotive force and also in the cheapness of manufacture.

It is also claimed that the active material in the porous pot, having a different molecular action from that of either red lead or litharge, will regulate its own resistance to the rate of charge or discharge.

THE PROPOSED ELECTRICAL TRANSMISSION OF POWER AT AUSTIN, TEXAS.

The large dam across the Colorado River at Austin, Texas, built mainly for the electrical transmission of power, has been completed, but the recent panic has so seriously affected the ability of the city to float its bonds for the purpose that the electrical work will, it is thought, be seriously delayed. By popular vote, the city council was authorized to issue $1,500,000 of bonds for constructing the dam and plant. Meantime, a description of the dam itself will be interesting in view of the amount of water power transmission work now being done or contemplated throughout the country. The enterprise was undertaken shortly after the Niagara plant was begun, and the existence of the dam is directly due to the adoption of the Niagara plans by the Cataract Construction Company. The Austin people had been unable to make use of their power to good advantage, owing to the limited building sites in the vicinity of the river, until the idea of electrical power transmission was taken up in the North, when they immediately fell into line and authorized the issue of $1,500,000 in bonds to construct a dam and plant suitable to their requirements.



Dam Across the Colorado River Near Austin, Texas.

A point three miles above the city, where the river is narrowed by rocky cliffs exactly opposite to one another, and where its solid limestone bed affords a perfect natural foundation, was selected as the most suitable base of operations. The dam there is of solid masonry, 1,150 feet long, 6 feet high above low water, 66 feet wide at the base and 18 feet at the top. The upper and lower faces are of granite blocks of from 25 to 40 cubic feet, and between these is a filling of limestone blocks cemented together. The water, flowing over the dam forms a beautiful fall nearly one-third as high as Niagara, and the river behind it has been changed into a lake thirty miles long and at several points reaching a width of nearly two miles. There are already two small steamers plying upon its surface and pleasure craft of all sorts are to be seen in abundance.

It is estimated that one hundred thousand horse power can be furnished when the plant is completed, which will be more than enough for the street railway systems and factories of Austin and for the many other manufacturing establishments which, it is thought, will be attracted to the neighborhood. Austin is to-day a city of 25,000 inhabitants. On the usual average of 5 people to every horse power developed, it hopes to reach 500,000 in the not distant future.

HOW TO MAKE THE TROLLEY CURRENT "DEADLY."

It is a well-known fact that it is next to impossible, if not, indeed, quite impossible to kill a human being with the trolley current, under ordinary conditions. The following dispatch appears to contain a recipe for getting out of a trolley current all there is of really useful deadliness in it:—

> St. Louis, Mo., May 9.—William Berg, the 16-year-old son of Lawrence Berg, a railroad watchman at the Anheuser-Busch Brewery, met an instantaneous death by electricity this afternoon in front of his home. He had just finished his dinner, and, going out on the street to play with his younger brother, took a coil of thin wire from his pocket, tied a stone to one end of it, and pitched it over a trolley wire in front of the house. As it descended he caught the wire wrapped stone in his left hand, and, as the other end of the wire was coiled around his right arm the circuit was completed. He fell to the ground a corpse.
>
> A passer-by broke the wire with a stick, and then carried the dead body into the house. The doctor found that the boy's right arm had been cut, the fingers of his right hand sliced to the bone, and one finger burned off. There was a hole about half an inch wide down to the bone in the boy's left breast, just over the heart, where the current must have entered the body from the wire just as the boy's hands were forced up to his breast when he first caught hold of the wire.

POLYPHASE MOTORS.[1]

BY CHARLES P. STEINMETZ.

THE modern polyphase motor, as distinguished from the earlier motors of Tesla and others, has very great superiority—in addition to that of low period—which should contribute essentially to the success of these later motors. These improvements can be characterized briefly by saying that they are the same that were brought about in the mean time in the building of dynamo machines and alternate current transformers, viz.: Better arrangement of the magnetc circuit through the use of an iron-clad construction without sharply defined pole-pieces, and the substitution of a toothed for a smooth armature; the lowering of the self-induction through the nearer approach and recession of the primary and secondary windings; constant co-efficient of self-induction in all positions of the armature and all the further improvements that our present knowledge of the laws of the magnetic and electric circuit has prompted.

The last year has been extraordinarily fruitful in mathematical and theoretical investigations of polyphase motors, and probably six or a dozen theories have appeared. Of course, no two agree with one another in their conclusions or with practice.

Since, moreover, the mathematical theories of such apparatus are written up for the most part only by theorists who never constructed a motor themselves and who have never seen a motor taken apart, it is entirely conceivable (and not to be expected otherwise), that one of these theories leads to the conclusion that the self-induction of the motor armature should be as great as possible. Practical experience shows that the main problem of the construction of such motors consists in having the armature self-induction as low as possible; while a second theory sees in hysteresis the cause of the action of such a motor, whereas experience shows that the less the hysteresis, so much the better does the motor work. Concerning the starting torque, drop in speed under full load, phase difference, etc., the wildest confusion reigns in view of the varying theories that does not become at all lessened on account of the ingenious method of construction of such motors; and there is confusion whether to give the starting torque in kilograms or in per cent. of the full load torque, and to determine how much more current the motor consumes in starting than under full load.

It is therefore only to be expected that the present position of the polyphase induction motor industry, as reflected in the Chicago Exposition and in the publication of the electrotechnical journals, is thoroughly discouraging.

The construction of polyphase motors must still be deemed faulty as long as it is mentioned as something particularly noteworthy that "small motors use no friction clutch but start under load"; or, when it is stated as the reason for starting without load that "a current consumption above the normal should be avoided in starting." If the polyphase motor cannot start with normal current consumption under full load, it and the whole polyphase system with its three or four conductors is entirely superfluous, since the ordinary alternating or single phase motor starts without load and is in every way as good as the polyphase motor in efficiency, performance, etc.

If we review the numerous polyphase induction motors presented at the Chicago Exposition, we still find them all, with the exception of some small three-phase motors of the General Electric Co. of 5 to 15 h. p., possessed of the same faults, viz., small starting torque and in consequence of this, abnormal current consumption in starting under full load and in some of them even complete inability to start with full torque; high self-induction and consequently considerable phase displacement; great dropping off in speed under load and stopping altogether under overload,—all characteristics which are to be pointed out as faults of construction, since they can be avoided.

It would carry me too far to give here a complete theory of the mode of action and method of calculation of polyphase induction motors, and it may thus be sufficient to give some theoretical conclusions, which I have found confirmed by experience in properly constructed motors.

First of all, attention must be called to the fact, that polyphase motors can be calculated in advance, completely and with the greatest exactness, just like ordinary direct current motors, in all their essential characteristics, such as starting torque, efficiency, phase displacement and fall of speed under varying loads, maximum possible overload and corresponding torque, no-load current and current strength under varying loads, and the variation of these quantities under alteration of the impressed electromotive force or of the period, etc.

1. *Starting Torque.*—In the ordinary polyphase induction motor the same torque per volt-ampere—or under some conditions a few per cent. more—is obtained in starting as under full speed and full load, so that the motor can start under full load without consuming any more current than it does under full load and speed.

However, by special construction of the motor a starting-torque can be obtained which is two or three times as great per volt-ampere as under full speed and load, so that the motor starts with two or three times the torque without consuming any more than the normal current. This shows the extent of the faulty construction in the case of 5-horse motors that consume 15 h. p. of current in starting.

2. *Overloading.*—The polyphase induction motor can stand a considerable overload without being stopped or dropping off much in speed. How much overloading may be permitted depends upon the conditions under which it is used and the size of the motor. In many cases we can figure on more than 100 per cent. overload; in others, especially large motors, only between 50 to 100 per cent.

3. *Drop in Speed.*—The falling off in speed between no load and full load can be made small or great, at pleasure, without changing essentially the remaining characteristics of the motor. In general, the drop in speed under full load in the polyphase motor is smaller than in the direct current shunt motor of equal size.

4. *Efficiency.*—The efficiency should be at least equal to that of direct current motors. Moreover, the same principle holds good here as in the direct current motor, viz., the higher the efficiency the more costly the motor, and *vice versa.*

5. *No-Load Current.*—The no-load or exciting current, *i. e.*, the current which is consumed when the motor runs without load, must be small and should not exceed 20 to 30 per cent. of the full load current, except in special motors for extraordinary purposes, as for example, where a motor is intended to carry a momentary overload of several hundred per cent. without a large drop in speed.

In this, and in respect to starting torque, faulty construction shows up most strikingly.

6. *Phase Displacement.*—The phase displacement of the current behind the E. M. F. ought to be small and the power factor, or the relation of the true to the apparent watts, ought therefore to be high. In large motors it is 0.90, or higher, from ¼ load to 50 per cent. overload, and in small motors it should not be below 0.80 per cent.

The phase displacement in the motor consists essentially of three different components:

(*a*) The self-induction of the armature which shifts the armature current behind the induced E. M. F. and influences the primary current, according to the principle of the alternate current transformer. This phase displacement varies with the load in an increasing ratio, and is the main factor that limits the maximum output of the motor.

(*b*) The self-induction of the primary circuit which causes the current to lag behind the impressed electromotive force. This phase displacement increases with the load.

(*c*) The magnetizing or exciting current which causes the primary current to lag behind the impressed electromotive force. Since the magnetizing current is approximately constant, this displacement diminishes with increasing load, approximately inversely proportional to the load.

We see, therefore, that one of these components, the magnetizing current, relatively decreases, while both the others increase, so that with an increasing load the phase displacement decreases from a maximum at no load, reaches a minimum, and then again increases.

7. *The Period.*—The period is generally arbitrary and polyphase induction motors can be built just as well and with the same efficiency for 130 periods as for 30, supposing that the magnetic disposition is the same. In order to satisfy these conditions, a greater circumferential speed must, however, be chosen for a higher period, and finally a point is reached where a further raising of this speed is not desirable on mechanical grounds; hence the same advantageous disposition cannot be further retained, but the distance of the neighboring poles must be lessened, which produces, in consequence, a greater self-induction and with it a greater phase displacement of the motor.

Up to 60 or 80 complete cycles per second this question need not be taken into consideration, and polyphase motors can be made for any period with the same efficiency, no-load current, phase displacement, etc. Nevertheless, polyphase motors for 130 periods can be built which start with full load and normal current strength, and which differ from motors of lower period only in a somewhat greater no-load current and a somewhat higher phase displacement.

In view of the above-mentioned conditions it is easy to render an opinion concerning the construction of polyphase motors. The condition of large starting torque is essential inasmuch as it represents the only point of superiority that the polyphase induction motor has over the single phase induction motor, which latter attains only 50 or 60 per cent. of the full load torque per volt-ampere (under the most favorable circumstances). If this condition were abandoned, the polyphase system would be entirely superfluous and the single phase or common alternate current system, in all other respects by far superior, would be preferred.

Further, it is to be pointed out as erroneous to use induction motors in all cases where alternate current motors are desired. On the contrary the synchronous motor is so far superior to the induction motor as the transmission element, that in all cases where a synchronous motor can be employed, the employment of an induction motor is to be pointed out as a mistake, since the synchronous motor, on account of its high efficiency and small size, and, where it is desirable to have control of the pressure, has the advantage of having no phase displacement; or, indeed, where it is desirable to have control of the pressure, of having a negative phase advancement. In other words, while even in the best induction motor the current is always shifted behind the pressure, the synchronous motor can be so made that the current is always in phase with the E. M. F.; the no-load current is thereby diminished and the current consumption is proportional to the load, as in the direct current motor.

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[1] From the *Elektrotechnische Zeitschrift.*

The polyphase synchronous motor is self-starting either with no load or with a moderate load. Thus, for example, a synchronous motor should have been used in the Frankfort-Lauffen power transmission, and not an induction motor.

NOTES ON THE MIDWINTER FAIR.

(From a Special Correspondent.)

THERE is a suggestion of summer rather than of "Midwinter" in the bright green of the grass and the blooming of the flowers in the Grand Court of the Sunset City. The varied and harmonious coloring of the surrounding buildings adds greatly to the beauty of this Court, giving the beholder an impression of a palace garden in some tropical clime, rather than of an exhibition of the appliances of modern civilization.

There are 120 Wood arc lamps around the Court placed 16 feet above the ground on poles about 30 feet apart and connected by underground wiring. Current is supplied by the Wood arc dynamos, situated in the Mechanic Arts building, as part of the exhibit of the Fort Wayne Electric Co. This exhibit is in charge of Mr. F. G. Cartwright, who represents the Fort Wayne Co. on the Pacific Coast. A slow speed alternator, 175 K. W. capacity of Wood's latest type is also shown in operation, carrying the day load of incandescent lighting and occasionally taking the place of the General Electric alternator on the night supply. This alternator is compound wound, with iron-clad armature and self-oiling boxes. The Fort Wayne Co. was the first to make a contract for lighting with the Midwinter Executive Committee, the first to install and the first to turn on the current. The lighting of the Palace of Mechanic Arts and of the Horticultural Building is in the hands of the Standard Electric Co., of Chicago. Four dynamos of this make are installed in the Mechanic Arts Building. They are the fifty-light size and are giving most satisfactory service.

The large collection of engines furnishing power for the electric installation is a varied and interesting one. A large proportion of the power is supplied by California built engines and of these four are deserving of special mention, indicating as they do, that Pacific Slope engine builders are in the front rank of advancement in this branch of manufacture.

An Ohmen compound engine of 150 h. p. is running three of the Standard arc machines. This engine was built in San Francisco by W. H. Ohmen and has an established reputation on the Coast for efficiency, durability and steady motion.

It is of the positive cut-off type, with shaft governor, hollow plug balance and oscillating valves one inside the other, taking steam through the centre and exhausts underneath. The valve stems do not require any packing and all the adjustments are on the outside, while the valves take up their own wear automatically. There are two eccentrics; one is fast to the engine shaft and operates the main valve direct in the ordinary way, admitting the steam and exhausting at proper times, while the other eccentric is loose on engine shaft, but is worked forward and back by the weights of the governor and acts direct on the cut-off valve, admitting sufficient steam to do the work on the engine. The valves travel in opposite directions, which gives them a quick closure, an important point in cut-off engines, avoiding wire drawing of steam. In the compound type the low-pressure cylinder is worked by a plain slide valve.

Next to the above is a Pitchford Corliss, built by W. T. Garratt & Co., of San Francisco. This engine is constructed with non-detaching valve gear and the cut-off is controlled by a governor on the engine shaft.

There are floating levers on the steam valve arms, one end of which is moved by the main eccentric through the rock plate and connections and the other end is moved by the cut-off eccentric through a bell crank mechanism which produces an alternate pausing and accelerated motion. The position of the cut-off eccentric is controlled by a governor on the engine shaft which regulates its angular advance. The steam valves are double ported. In other respects the main features of the engine are similar to those of other well designed Corliss engines. A 3,500 light Wood alternator is run by this engine.

The Union Iron Works exhibit an upright compound engine of 600 h. p., one of four which they have just completed for the Mission street electric railway of San Francisco, one of the others being 600 and two 300 h. p. each. The cylinders are 22½ and 39 inches with 24 inch stroke and the revolutions numbering 165. The high pressure cylinder has a piston valve and the low pressure on American balance slide valve. The design is such that the greatest accessibility to all parts is obtained and also great simplicity. This engine furnishes power for two 150 K. W. Western Electric generators and is belted direct.

Thompson's slide valve Corliss engine is also giving excellent service running the Edison dynamo which furnishes current for the electric fountain and for the two searchlights. This is built by the Golden State and Miner's Iron Works of San Francisco, which has many very flattering testimonials from those using this engine in some of the most important enterprises on the Pacific Slope.

There are one each of the following Eastern engines, furnishing power for the electric plant:—N. Y. Safety 12 x 12, Payne 12 x 12, Buckeye 14 x 24, Russell 18 x 20, Ball 12 x 12. There are also four of the "nondescript" class, which, considering the fact that they have all passed through various stages of operation, dismantling and rebuilding are doing remarkably well.

SMALL OR SUB-DIVIDED ARC LIGHTS.

BY F. B. W.

Having recently read a great deal in the ENGINEER about the possibilities and uses of small electric arcs, or the so-called sub-divided arc lamps, I would like to call your attention to what has been done, and is still being done at present, in this line by the series system, as manufactured and first introduced by the Ball Electric Light Company, of New York City. This company is, I believe, the pioneer in "sub-dividing" the high tension arc light system. The arc as used by them is not sub-divided horizontally by using low voltage, which would have a tendency to produce a poor light, but the quantity of the current passing is divided, and a higher electromotive force is used which has proved to be very economical, and produces a noiseless and perfectly steady light (except the slight variations, caused by impurities found in the carbons.) These lamps run on a constant current of 4 amperes, and each lamp requires from 50 to 58 volts per lamp, or from 200 to 236 watts per lamp. These lamps are guaranteed three to the horse power, or in other words, they require less than one-third of an electrical horse power each.

In regard to the candle power of these lamps, and figuring them in the same proportion as the so-called 2,000 candle power 450 watt lamp, they can safely be rated at 800 candle power; the carbons generally used are plain soft, 7/16 of an inch in diameter.

The lamp used is a modification of the Ball 2,000 c. p. lamp; the only changes are in the windings of the line and shunt spools and in the adjustment of the lamp; for line wire they generally use No. 8 B. & S.

The generators used for this system are the well known double armature Ball dynamos (which was fully illustrated and described in THE ELECTRICAL ENGINEER of Nov. 30, 1892) and are perfectly automatic in action from one light to the full load of the dynamo, and are built at present in three sizes for this 4 ampere system, viz., 25, 50 and 70 lights capacity each. This sub-divided arc light system has been in successful operation for the past four or five years in various parts of the United States, Canada, Mexico, Central and South America and has given great satisfaction wherever installed, and nearly 150 plants, supplying upwards of 4,000 of these lights, are in daily successful use.

They are giving great satisfaction, especially in street lighting work for villages and towns, these 800 candle power lamps have frequently replaced 1,200 and 2,000 c. p. lamps for town lighting where shade trees have made economical lighting by arcs of greater or larger candle power placed at great distances an impossibility, and have also replaced the same class of lamps in cotton and worsted mills, where, by putting in a greater number of these small arcs to thoroughly distribute the light, overcome the shadows from the more powerful arc lamps. They light the premises more satisfactorily and cheaply than either the incandescent system or with arc lamps of a greater candle power, and at less cost than either of the two methods. One worsted mill in Massachusetts has over 600 of these small arcs in use; another worsted mill in Providence, R. I., has a plant of 400 of these lamps and the owners say that they are much superior than either gas or incandescent lamps and answer their purpose better. In street lighting these small arcs have met with the same success, and for towns and villages having shaded streets they offer the best and cheapest method of lighting so far devised, and they have replaced several incandescent street lighting plants.

One of the most recent plants of this type has just been installed for the Jamaica Electric Light & Power Co., of Jamaica, N. Y., and consists of two dynamos of the G. 4 type and 140 all night single carbon Ball lamps, using a plain ½ inch carbon, and giving a run of from 15 to 16 hours, without recarboning.

I would certainly advise any person having any doubts about this system of street lighting for small towns and villages to pay a visit to Jamaica and see for himself what can be done by a small sub-divided high tension arc system. I would like also to state here that the Ball Company still continues to manufacture their old standard 1,200, 1,600 and 2,000 candle power arc systems, and they have recently greatly improved their apparatus in electrical and mechanical details.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE BONNEAU & DESROZIERS HIGH SPEED ELECTRIC LOCOMOTIVE.

THE application of electric locomotives to railways designed for steam traction exclusively has been, and is being, attempted in France to a greater extent than in any other country and with most encouraging results. The Heilmann electric locomotive, which was illustrated and described in our issue of May 17, 1893, and whose successful trial trip we noted on March 21, last, has, we learn, been adopted for regular service by the Eastern Railroad of France and will haul one or more trains daily between Paris and Nantes.

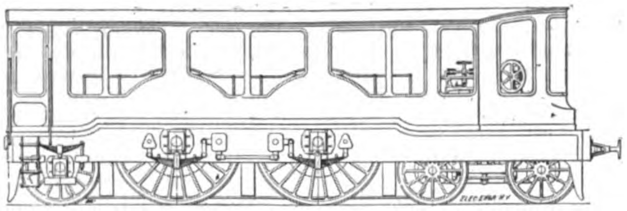
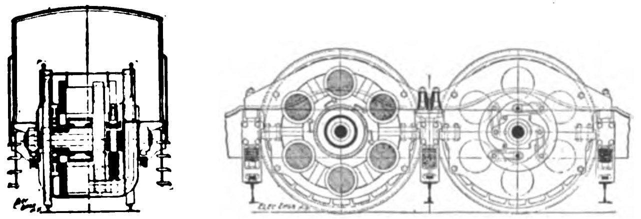


FIG. 1.

It is interesting, therefore to learn that still another type of electric locomotive for fast passenger service is now being built from the designs of Messrs. H. Bonneau and E. Desroziers, by the Paris, Lyons & Mediterranean Railroad, of which M. Bonneau is chief engineer. The accompanying illustrations show the salient points of the new locomotive. There are four driving wheels on the leading truck, which is so arranged as to give, with a two-wheel trailing truck, a rigid wheel base of 15 feet, 7 inches. The frame is supported by half elliptic springs. Powerful springs hold the leading truck normally in a central position, while allowing considerable lateral motion; and the frames are placed outside of the drivers to gain space for the motors, which are six pole Desroziers slow speed machines mounted upon the axles.[1] The armature shafts are hollow, giving a sufficient clearance between them and the axle, and power is transmitted by means of a system of drag links, as shown in Figs. 2 and 3.

The commutator of the motor is placed close to the armature and the brushes are reached through the openings between the pole pieces. Heavy lugs on the motor frames support the field magnets through the medium of vertical rods attached to U-shaped girders provided with buffers to avoid vertical shocks. Secured to these girders beneath the motors is a casing to protect the bottom and sides of the motors from dirt and moisture, while their upper parts, with the exception of the commutator, are left uncovered, but are shielded by the light cab that encloses the whole locomotive.

As it is desirable to avoid if possible the necessity of stringing trolley wires along the road, current will be supplied by storage batteries carried over the leading truck. The motorman will stand at the front where he may have an unobstructed view of the track, and where all the controlling and braking devices will be assembled. The first locomotive built will be rated at about 300 h. p, though that illustrated here is designed for a maximum of 1,200 h. p. and will have a total weight of 136,685 pounds.

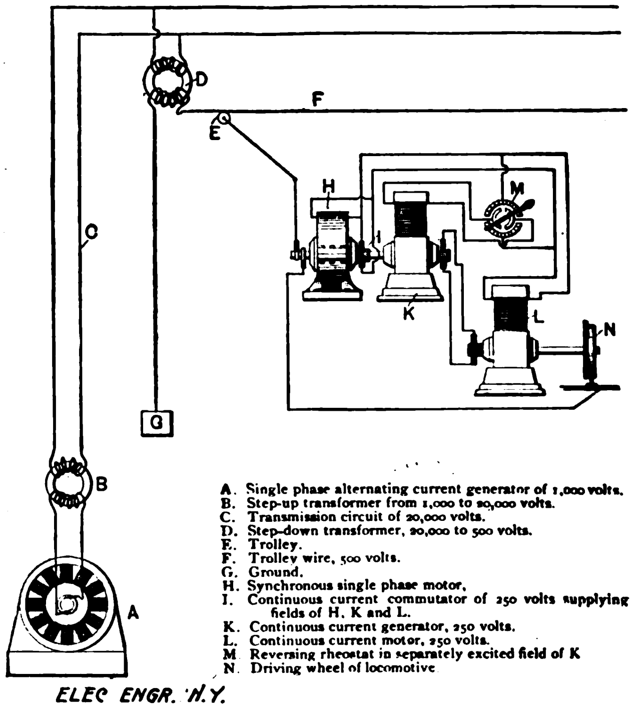


FIGS. 2 AND 3.

HOW SHALL WE OPERATE AN ELECTRIC RAILWAY EXTENDING ONE HUNDRED MILES FROM THE POWER STATION?[1]

BY H. WARD LEONARD.

LET us suppose that a steam railway desires to use electric locomotives, the generating station being 100 miles from either end of the road. The following features seem desirable, if not essential, in such a railway: 1. A single trolley contact shall be used for supplying current to the locomotive. 2. The E. M. F. upon the trolley shall not exceed 500 volts. 3. There shall be no apparatus in motion and requiring attention, between the power station and the locomotive. 4. No commutator, rheostat or controlling device on the locomotive shall be subjected to a higher E. M. F. than 250 volts, and there shall be no sparking on any of the apparatus under any normal conditions. 5. The entire control of the locomotive in either direction shall be effected by the movement of one lever. 6. The load shall be started from dead rest by an amount of energy taken from the source of supply, which shall not exceed one quarter of the energy required to operate at full speed on the level.



A. Single phase alternating current generator of 1,000 volts.
B. Step-up transformer from 1,000 to 20,000 volts.
C. Transmission circuit of 20,000 volts.
D. Step-down transformer, 20,000 to 500 volts.
E. Trolley.
F. Trolley wire, 500 volts.
G. Ground.
H. Synchronous single phase motor,
I. Continuous current commutator of 250 volts supplying fields of H, K and L.
K. Continuous current generator, 250 volts.
L. Continuous current motor, 250 volts.
M Reversing rheostat in separately excited field of K
N. Driving wheel of locomotive

LEONARD LONG DISTANCE ELECTRIC RAILWAY SYSTEM.

7. The retardation of the load in coming down grades, and in stopping, shall be effected by converting the motors into generators, which shall feed back current to the line, and thereby assist the power station in operating other locomotives. 8. The motors must be reversible when operating at full speed, without damage to the motors or other apparatus. 9. The efficiency of the system from power on the generator shaft to the draw bar pull of the locomotive, shall be at least 50 per cent. 10. The locomotive shall produce at least 500 h. p., when operating at a speed of 80 miles per hour.

It will be evident that we must use a high E. M. F. for operating over such great distances. The average distance over which the power is to be transmitted is 50 miles, and we find that in order to operate with a loss in conductors of 20 per cent., we must have an initial E. M. F. of 20,000 volts, in order to make the cost of copper about $20 per K. W. which is about the best figure for cost of copper under the conditions. The alternating current must evidently be used for such an E. M. F. as this, and the single phase alternating, since we have but one trolley contact.

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[1] A very full description of Desroziers' dynamo-electric machinery, with 29 cuts. was given in THE ELECTRICAL ENGINEER, Vol. XVI., No. 281, Sept. 20, 1893, p. 259 et seq.

[1] Abstract of a paper read before the American Institute of Electrical Engineers, New York, February 21st, 1894.

Let us start (see Figure) with the standard 1,000-volt single phase alternators in our power station, and convert by step-up transformers from 1,000 to 20,000 volts required for the transmission circuit. Since we are limited to 500 volts upon the trolley, we must insert at suitable points, say every two miles, a converter, which will transform the energy at 20,000 volts in the transmission circuit, to energy at 500 volts in the trolley circuit, one pole of which latter circuit will be the rails.

The energy is then delivered at the point of use, but the single phase alternating current is not very flexible. A synchronous alternating current motor cannot be started under load, regulated in speed or reversed, but we may start it without load and, by means of gearing, apply it to its work when it has attained its synchronous speed, when we shall obtain the desired control, and the motor will operate at any speed in either direction, provided it be not subjected to too sudden fluctuations of load. No satisfactory mechanical gearing for this purpose is obtainable, but the same result is had by making the synchronous motor drive a continuous current generator on the same shaft at a constant speed, taking the current thus generated to propel the motors.

Since the generator is used for the motors on one particular locomotive only, we can vary its E. M. F. at pleasure, and hence can produce a low E. M. F. for low speeds and increase the E. M. F. to increase the speed, and by this means avoid the loss of energy which is wasted in rheostats when motors are started under load, and when connected as usual upon a source of constant E. M. F. The best results will be obtained by separately exciting the field, and keeping it fully and constantly excited and reversing the motors by reversing the field of the generator which of course will reverse the current in the armature alone of the motor. To secure this exciting current for the synchronous alternating motor, and also for the fields of the continuous current generator and motor, it will be best to drive by means of the alternating motor armature, and if desired in the same field, a continuous current winding connected to a commutator, from which will be led the current for exciting the fields of all three machines.

Let us wind the fields for 250 volts, and also use this voltage for the continuous current armatures. This pressure is perfectly safe and can be handled with impunity. Suppose now the locomotive to be at rest. The synchronous motor is running and driving the generator armature at full speed in a field of no intensity, hence the propelling motors receive no current. We now make the first contact upon the rheostat in the generator field circuit and let the resistance in the rheostat be such as to produce, say, 25 volts at the generator brushes. This 25 volts will supply a very large current to the motor armature at rest in its saturated field, and consequently will produce a sufficient torque to start the entire load and continue to move it at a slow speed. We are using 25 volts and, let us say, 2,500 amperes in this circuit; this means 62,500 watts and, disregarding transformation losses for simplicity, this means a current of 225 amperes from the trolley. When operating at the rate of 500 H. P. at full speed we shall need, say, 1,800 amperes at 250 volts in our propelling circuit, which is 450 K. W. and means roughly 900 amperes from the trolley. It is evident therefore, that we can start the load with but a small fraction of the energy required for operation at full speed, and that there will be no danger of throwing the alternator out of step by applying but about one-sixth of its full load and applying that gradually as will be the case, as the load will follow the increase of the generator field strength, which although rapid, is gradual and not instantaneous.

If we are operating at full speed, and desire to bring the locomotive to rest, we gradually, but rapidly, reduce the strength of the generator field by manipulating the rheostat in its field circuit so as to reduce to zero the current exciting this field; the E. M. F. produced by the generator then rapidly falls below the counter E. M. F. of the motors, which are being driven in a constant field by the momentum of the moving load, and the motors consequently become generators, and supply current to the former generator which now becomes a motor, and, driving the alternator, feeds current back through the trolley, thereby not only bringing the locomotive smoothly and rapidly to rest, but saving the energy usually wasted upon the brake shoes. Under this arrangement, if we are using steam engines as the source of power, we never subject the engines to the violent fluctuations ordinarily met with in electric railways, and by reason of having a comparatively steady load, can secure very high economy in the consumption of steam, and since we have eliminated the excessive load in starting, we can very much reduce the capacity of the engines, generators and conductors over usual requirements. The reversal of the motors is very simple and smooth by this method. The lever of the rheostat in the generator field circuit is moved, so as to first reduce the current to zero, and then increase it again to its maximum, but in the opposite direction around the field. The reversal of the motor armature, following the gradual change in the strength of the generator field, is extremely smooth, and the armature is not subjected to any sudden strain. No sparking will be met with under any conditions, upon either the generator or motor commutators, or upon the field rheostat.

THE TROLLEY BALLOON AT ANTWERP.

At the Antwerp International Exposition, it is said, will be a novelty in the shape of a navigable "trolley balloon" built after plans suggested by Lieut. Clement de St. Marcq. Current is to be supplied to a motor in the car of the balloon which will operate a propeller, and the flexible conductor will travel along an elevated line as the balloon moves, à la trolley. The balloon will be of an elongated form about 280 feet in its greatest measurement, and will weigh, with passengers, about 18,900 pounds.

The car will be divided into three distinct sections; the centre, which is the governing station, is occupied by the motor man, who has under his hand all the levers and appliances necessary for the manœuvring of the balloon; it is also here that the cable is attached, which binds the balloon to the aerial way or track. The forward part of the car is reserved for passengers. It has the appearance of the saloon of a steamer, is luxuriously arranged, and will accommodate thirty people.

The rear section is reserved for the machinery. Here is situated an electric motor of 145 h. p., which operates a propeller 26.24 feet in diameter, having four blades, which, in average weather, is capable of giving the balloon an estimated speed of 25 miles per hour, and a reel for the automatic winding and unrolling of the flexible cable. At the end of each voyage and during the night the balloon is to be moored to a turning plate, which transforms it into a huge weather vane, and allows it to move gently with the wind, and yet not suffer from its effects.

The aerial track is composed of three cables, each about an inch in diameter, constructed of galvanized steel threads, and having a breaking strength of 55,000 pounds each. The cables are supported on pillars 98 feet in height, placed along the streets. The current is conveyed along the aerial way to the trolley, from the trolley to the flexible cable, and from that to the motor in the car. The track is to be laid from the city to the fair grounds, about a mile.

EX-STATE SENATOR BOYD'S CONDUIT RAILWAY.

Last week ex-State Senator J. J. Boyd appeared before the New York Railroad Commission and submitted drawings and specifications for a new conduit railway system. In explanation Mr. Boyd said:

"The device consists of two insulated concentric circular boxes, the outer one revolving at a distance of about two inches from the inner, which is stationary, both hermetically sealed, having only one joint, through which a branch of the charged wire passes. As the shoe attached to the car passes over this box it comes in contact with a knob on the upper surface of the outer revolving box and tilts it slightly over, so that a bar which passes from this knob is brought in contact in the inside of the inner box with that portion of the charged conductor which has been deflected from the main conductor, thus establishing electric communication with the motor on the car. Before the shoe passes over one of the contact devices it comes in contact with another, so that the current to the motor is continuous. The space between the outer and the inner boxes is filled with paraffine, both the concentric boxes are insulated, and the conductor insulated everywhere except at the point of contact with the movable bar in the inner box. This device gives absolute security against any danger from escaping electricity. The contact boxes are both completely air and watertight. Each of these contact boxes, with labor of setting, would cost only about $10. The total cost of equipping a mile of railroad with all these necessary appliances would be about $2,650."

NASHVILLE, TENN., STREET RAILWAYS.

The United Electric Railway franchises in Nashville, Tenn., have been sold under a decree of the United States Circuit Court to Nat. Baxter, Jr., representing the bondholders, for $138,500. The sale is subject to $1,516,000 underlying bonds. The company operates forty-six miles of railroad in Nashville.

THE CONNECTICUT RAILWAY LAW.

The unlooked for discovery has been made that the new electric railway law of Connecticut probably makes the towns and cities liable for bridges which have to be rebuilt or strengthened for the transit of electric cars. If this interpretation of the law prevails it will cost the Connecticut towns large sums.

The State Railroad Commission, of New York, has now been authorized by law to act as the authority to award the $50,000 prize offered by the Metropolitan Traction Co. for the best method of propelling street surface railroad cars.

St. Joseph, Mich.—The contract for the St. Joseph and Lake Shore Street Railway has been awarded to L. J. Highland, of Chicago, the Chicago Electric Truck Company furnishing the trucks. The road will be eight miles in length, double track and is expected to be in operation by July 4th next.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

New England Editor and Manager, A. C. Shaw, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. Kammeyer, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada,	per annum,	$3.00
Four or more Copies, in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies,		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

Vol. XVII. NEW YORK, MAY 16, 1894. No. 315.

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UNDERWRITERS AND ELECTRICITY.

PRESIDENT SKILTON of the National Board of Fire Underwriters, at the annual meeting held in this city last week, did not hesitate to characterize the year 1893 as one whose record of adversity was unparalleled in the history of fire underwriting in America, "for widespread and continuous disaster." Tables embodied in his most valuable address go to show that 244 home and foreign companies received $134,984,282 in fire premiums and paid out the enormous sum of $90,344,075 for actual fire losses. When the loss and expense ratios for 1893 were added together, the expenditure for the year amounted to 101.77 per cent. of the premium income of the year, leaving out of account a proper margin for the outstanding liability or risks still in force at the end of the year! In other words, the nation's loss by fire was largest in the year when it was least able to stand it, and when the total waste appears more than ever in its true colors as a shocking and sinful crime against public welfare.

How shall the nation's loss be reduced, not merely for the welfare of the fire insurance companies but as an end to increasing public prosperity? Perhaps, when times brighten the flames will die down again, but even if the ratio of fire losses to each $100 of premium fall from its 66.93 of last year to the 54.34 of 1886, it will still be too high. Mr. Skilton makes various recommendations either to increase income or reduce loss, and in the category of preventive measures he calls earnestly for "concurrent action regarding our present greatest enemy, electricity." He adds that the experience of the last 90 days has shown "that fires caused by electricity are growing alarmingly frequent; and inspections show that but few buildings in any community are safely wired and that perfect insulation is rarely secured." These are strong, harsh words. We could wish there were less truth behind them.

It was fortunate that the treatment of this vital question did not stop at pointing out the danger. The Committee on Lighting, Heating and Patents handed in a very interesting report which said that the time had passed for burying wires in the plaster or placing them under the floors without protection. "They should be, whenever out of sight, not only thoroughly insulated, but so protected by tubing or otherwise, that the insulation may not be destroyed." They should, in short, be always accessible as well as protected. This is entirely correct and proper. The Committee recommended the Board to secure the adoption of a system of licenses for electrical mechanics, a matter in which one would think the unions could be of more service to everybody than in ordering strikes that so often are without excuse. But going even further, the Committee came out strongly against the overhead trolley system, which it realizes has its dangers not only in the wires that are above the ground but in those that are under the streets. "The use of the trolley itself in thickly settled towns is a source of danger such as your Committee believes cannot very long be tolerated." The Committee then takes a parting shot at the new apparatus for electric heating and cooking, not in an unfriendly spirit but pointing out the need of precautionary measures.

So far as the trolley is concerned, it is here to stay, but we have certainly reached the stage when in large cities the overhead wire may be easily dispensed with, for there are conduit systems available to any street railway company able and willing to pay for them. In regard to the other matters, we can only urge upon electrical engineers to co-operate as thoroughly and heartily as possible with the underwriters. It would, indeed, be well if the Institute at its meeting in Philadelphia this week, were to second the National Electric Light Association in the work that body has already done, and were to endeavor to serve as an intermediary between the two great commercial interests of insurance and electricity, still divergent on many important points.

INSTITUTE BRANCH MEETINGS.

When arrangements were made some months ago for the appointment of Local Honorary Secretaries and for the holding of local meetings of members of the Institute of Electrical Engineers, a New York member said, in conversation, that a generous rivalry would soon develop between such local meetings and the headquarters meetings at New York in the quality and merit of discussions on the papers read. That member's forecast has been happily verified by the local meetings at Chicago, of which two have now been held. Both were successful, as they were expected to be by all members, East or West, who were adequately acquainted with Chicago ability and energy. The Chicago discussion of Mr. Farnham's paper, last month, was particularly noteworthy for the knowledge and practical experience brought to bear upon underground electrolysis of cable sheaths and pipes by western members. Such meetings are no less honorable to the Institute than to its local membership in and about Chicago. Much of the success of the Chicago meetings is due to the intelligent and zealous work of Mr. Edward Caldwell, the Local Honorary Secretary, and to the courtesy of Professor Stine and his associates of the Armour Institute in providng a suitable room for the meetings. Let the good work go on.

THE WESTINGHOUSE REPORT.

The Annual Report of the Westinghouse Electric and Manufacturing Co., for the year ending March 31, 1894 —printed in full in this issue—discloses a prosperity somewhat in excess of that of the preceding year, the balance sheet showing an increase in earnings of $118,687 and in surplus carried forward of $18[illegible],196. In the text of the report Mr. Westinghouse says to the stockholders that the directors believe the exhibit of the company's situation will prove satisfactory. He may well say so, particularly in view of the extraordinary business depression characterizing more than half the year covered by the report. It is to be noted in this connection that the preferred stock of the Westinghouse Company is now quoted above its par of 50, while the common shares are at about 37. With the exception of the increase in surplus and a very considerable reduction in accounts and bills payable, there are no very noticeable changes in the items making up the assets and the liabilities in the balance sheet. Stockholders and possible investors could better judge of the company's condition if the report included schedules of the properties represented by the items of Bonds and Stocks set down as $237,397, and $3,988,992, respectively, as assets. Also, it would conduce to greater intelligibility if the amounts of sales and of operating expenses were stated. Industrial corporations are unduly chary of supplying information of this latter sort although their stocks and bonds are at public sale on the exchanges, like those of railway corporations. Conservatism in accounting would, we think, justify taking exception to the sum carried as an asset by the Westinghouse company in the item of "Charters, Franchises, Patents, etc." $4,379,881. A schedule of the charters and franchises would partly elucidate this. Patents, of course, have a real value as assets (we know of one large electrical corporation which carries its patent rights at a sum less than its annual receipts from royalties derived from them), but, in view of the fruitlessness and the cost of much important patent litigation of recent years, it is not too much to say that patents make a very shadowy asset for an electric manufacturing company when their value is stated in millions. The Westinghouse report shows no material increase in the patent account during the year, so the big figures may be called a relic of old days.

A warrantable tone of cheerfulness pervades the report, and we take leave to congratulate Mr. Westinghouse and the company on their freedom from the necessity of giving their best efforts to explaining deficiencies—a fate that has befallen not a few electrical companies during the past year.

ELECTRIC ROADS IN NEW YORK CITY.

Electrical traction is slowly but surely gaining an entrance into New York City. For some time past, a regular trolley system has been in successful use in its suburbs, and now a cross-town line, with familiar centre pole construction, runs along One Hundred and Thirty-fifth street. The citizens are next promised a trial of one or two conduit railway systems, notably the Siemens-Halske, to be laid at the builders' expense, on the West Side, where success will inevitably lead to adoption further down town. The present aspect of affairs is, therefore, one of great encouragement to electrical engineers. It is now pretty generally admitted that New York can enjoy all the advantages of electric traction, without any of the drawbacks of the overhead trolley; and we look forward to the early conduiting of more than one large road.

OBITUARY.

COL. STEPHEN M. CHESTER.

Col. Stephen M. Chester, until recently and for many years a resident of Elizabeth, N. J., died at his residence in New York last week. He was the son of the late Col. Thomas L. Chester, of New York. Immediately after his graduation at Yale, he went west in the pursuit of his profession as civil engineer, and laid out several railroads. When the war broke out he joined a corps of volunteer engineers, and before its close was promoted to be colonel. His talents and inclinations were always toward invention, and so he became expert electrician for the firm of C. T. & J. N. Chester, his brothers, of New York, and in connection with the senior member invented and put in the first telegraph fire alarm in New York. Among his many other inventions were an electrical sewing machine motor, and an underground trolley system. Just before his death, he invented a fire-escape. He had been consulting electrician for many of the best known electrical companies. When the war between Peru and Chili broke out he entered the service of the former country to superintend the use of electrical torpedoes. He was captured by the Chilians and imprisoned, though he tacked over his door a self-made American flag. The United States Government, however, soon demanded and secured his release. His death brings to a close a varied and eventful life.

Talmage's Tabernacle, Brooklyn, was destroyed by fire on Sunday for the third time. It is asserted that the fire started from a defective wire in the organ, but of this there is absolutely no proof. When the tabernacle was last destroyed, and when it was claimed that its wires had been "struck by lightning," the switchboard after its recovery from the wreck was found intact and without the slightest trace of such a casualty !

THE ARNOLD SYSTEM OF ELECTRIC POWER STATION CONSTRUCTION.

In building an electric power station the two principal objects to be kept in view are low first cost, consistent with the best economy, and absolute reliability. Power stations have heretofore consisted of two classes, viz.:—Those having a number of engines directly belted or directly connected to small generators and those having two or more large units of power belted to line shafting from which a number of small electric generators are driven by means of friction clutch pulleys and belts. In order to insure reliability with the first plant, it is essential to have one or more engines and generators in disuse all the time to be able to start in case of accident to any one of the operating units. In the latter system reliability is insured by being able to reach any dynamo from any engine in the plant through the shafting and belted connections. The former system has always been the cheapest to install in first cost, and the latter has been the most reliable to operate. The system described here is one which is said to combine the flexibility of the low speed, or large engine belted plant with the low first cost of the direct connected or direct belted plant. The advantages claimed for this system are: Less cost per kilowatt of plant installed; less cost in operating expenses; less real estate occupied; absolute flexibility; less depreciation, and greater ease in handling, than is usual in power plants heretofore installed.

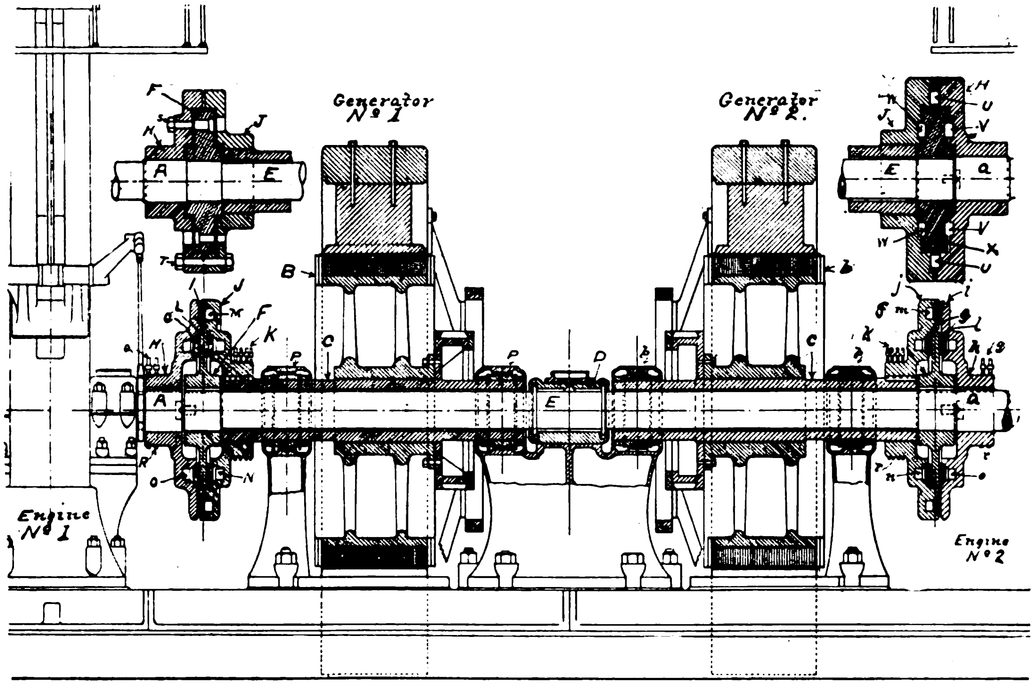


FIG. 1 (*a* and *b*).

We shall first describe the system as applied to an electric railway plant having a capacity of 2,000 h. p. such as would have been ample to drive the Intramural road at the World's Fair. Referring to Fig. 1, engines No. 1 and No. 2 are cross compound condensing, having a rated capacity of 1,000 h. p. each. Generators No. 1 and No. 2 bave a rated capacity of 750 K. W. each. The armatures of the generators are mounted upon hollow cast steel shafts or quills, C *c*, running in independent bearings, P *p*, so arranged that they are free to revolve independent of either engine. and of each other. Through these quills, and supported at its centre by bearing D extends a steel or wrought iron shaft, carrying upon its ends circular cast steel or cast iron discs, F *f*, securely keyed to the shaft. The drawing shows the engines connected to generators with magnetic clutches which operate as follows: Attached to the end of the engine safts, A *a*, are circular cast iron or cast steel discs, H *h*, carrying in recesses copper coils, O *o*, which are connected to brushes, Q *q*, by mean of rings, R *r*, in such a manner as to permit a current of electricity to be passed through the coils while the discs are in motion. Around the vertical faces of the discs near their peripheries are carried cast steel or cast iron rings, I *i*, which are held in position by means of three gudgeons or bolts, equally spaced around the peripheries of the dics. The rings I *i* are normally held against the discs by small spiral springs surrounding the gudgeons. Attached to the quills C *c* are cast iron or cast steel discs J *j*, carrying two coils of copper wire M *m*, N *n*, which are connected to the brushes K *k*, so as to allow a current to be passed through the coils when the discs are in motion.

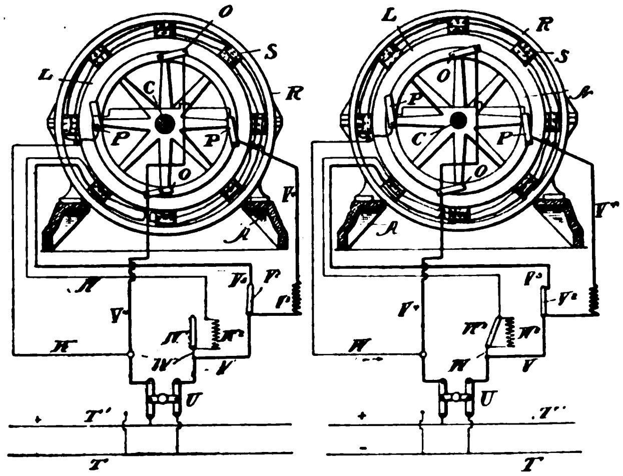
It is evident that if a current be passed through the coil M a magnetic field will be created around it which will have a tendency to attract the disc I, overcoming the action of the springs which normally hold it against the disc H, and clasping it securely to disc I so that power can be transmitted from one disc to the other by friction so long as the current travels through the coils. If engine No. 1 now be set in motion it will drive generator No. 1 directly connected, there being no wearing parts except what are ordinarily encountered in a direct connected engine and dynamo plant. In a like manner engine No. 2 can be connected to generator No. 2, thus forming two direct connected power units. The shaft E lies idle in the bearing D, and is not used except in case it becomes necessary to drive either generator from the opposite engine, or both generators from the same engine. In an ordinary direct coupled plant, if we had but two units of power, in case the engine of one unit and the generator of the other unit should become disabled, the plant would be at a standstill, and unable to furnish any current at all. With such an emergency as this, this system would operate thus: If engine No. 1 and generator No. 2 were the disabled portions of the plant, generator No. 1 would be driven from engine No. 2 as follows: Current would be passed through coil O thereby attracting the disc *l* which would set the shaft E in motion. Current would also be passed through the coil N attracting the disc L which would set the armature of generator No. 1 in motion. Current is then cut off from the coil M, allowing the armature of generator No. 2 to come to rest. It will be readily understood that either generator can be reached from either engine in a like manner, thus making it practically interchangeable.

Should one entire engine unit become disabled, both generators can be driven from either engine by simply passing the current through the proper coils as follows: If engine No. 2 were disabled, generator No. 1 would be driven directly from engine No. 1 by means of the coils M and disc I, as above described. Current would be passed through the coil N, thus attracting the disc L and setting the shaft E in motion. Current would now be passed through the coil *n*, attracting the disc *g*, thus setting the disc *j* of generator No. 2 in motion. Thus either generator or both generators are available from either engine, and at the same time there is not the additional investment of a third engine and generator to be carried to provide against the accident above mentioned. The fact of having to work the engine uneconomically while repairs are being made is a very small item compared with the heavy expense of carrying the additional investment of a third engine and generator to provide for this emergency, as is now usually done with direct coupled plants.

By having two engines with the high pressure cylinder of one and the low pressure of the other directly connected to the work, the plant is arranged to operate economically with any load varying from 500 to 2,000 h. p., and it is practically impossible to shut the plant down on account of any accident that would be liable to happen. The main shaft of both engines is cut in the middle and the two parts joined by means of positive jaw clutches, operated by steam cylinders. Thus, when the load is light, engine and generator No. 1 are shut down. Cylinder D of engine No. 2 is cut off by means of the jaw clutch, and no portion of the plant operates except the high pressure cylinder of engine No. 2, directly coupled to generator No. 2. This cylinder can be run condensing and the plant operated with economy, until the road requires more power, when the low pressure cylinder is brought up to speed and connected with the high pressure cylinder without stopping the plant. In case it becomes necessary to make repairs on the high pressure cylinder of engine No. 2 at the time that the road is demanding full power of engine No 1, high pressure steam may be admitted to the low pressure cylinder of engine No. 1, which is placed next to the generator. By working high pressure steam in the low pressure cylinder of this engine it will give its full power, thus driving its generator and allowing the high pressure side to be shut down for adjustment.

In order to prevent wear on the rings of the magnetic clutches above described, the following method of electrically starting the generators is covered under this system. Suppose engine No. 1 and its generator are operating, and engine No. 2 and its generator are standing idle, and it becomes necessary to throw generator No. 2 upon engine No. 1 in order to repair something on generator No. 1. Instead of starting engine No. 2 to bring generator No. 2 up to speed, or allowing the friction of the magnetic clutch to bring the latter up to speed, current from generator No. 1 is passed through the armature and fields of generator No. 2 in such a manner as to make a motor of it until the armature attains the same speed as that of generator No. 1, when current is passed through the coil *n* clamping the disc *f* to the disc J without wear on the clutch mechanism.

Figs. 2 and 8 give a diagrammatic representation of the circuits for operating the machines as motors and generators. Referring to Fig. 2, let us assume that generator No. 1 is running as a generator from engine No. 1. The circuit is as follows: From the positive bus-wire on the switchboard T^1, through the double-pole switch U, conductor V^4, brushes O O, armature L, to brushes P P, to field magnet coils S S, conductor V^5, switch V^2 and conductor V, to switch U, back to the other main conductor T. This machine is therefore supplying the main conductor with current. By disposing the parts as indicated in Fig. 8 the circuits will be varied so that the circuit of conductor V includes at first the high variable resistance V^3, and excludes the series winding of the field magnet, and the shunt circuit excludes the resistance W^2 by means of switch W^1, so a variable current may be made to pass through the armature by varying the resistance V^3. Thus the machine operates as a shunt motor and its sleeve shaft is driven at any desired rate of speed by simply adjusting the resistance V^3. The rotation of the sleeve shaft will vary from the rotation of the main shaft, and when the armature of machine No. 2 has attained approximately the same speed as the shaft O, the magnetic clutch is thrown in circuit, the proper switches are thrown, and generator No. 2 ceases to be a motor, and becomes a generator capable of producing current.



FIGS. 2 AND 8.

In case it ever becomes necessary to increase the capacity of the power station designed under this system, it is done by adding two more generators to the right of engine No. 2, having similar connections to generators No. 1 and 2, thus making four generators available from engine No. 2. The third engine is added as the power is required.

Figs. 1*a* and 1*b* show different forms of mechanical clutches which can be substituted for the magnetic clutches above described if necessary. In a railway plant the fact of having to stop the station for a few minutes at the time of changing from one engine to another is not so serious as in a lighting plant, and the above clutches have been designed for substitution for the magnetic clutches in case the conditions are such as not to warrant installing the magnetic clutches. In Fig. 1*a*, H is a disc securely keyed to the shaft A of engine No. 1, J is a circular disc securely keyed to the quill C of generator No. 1, and F is a circular disc keyed to the common shaft E. If it is desired to drive generator No. 1, three bolts T, spaced equidistant on the circumference are used to bolt discs H and J rigidly together, the same as cable railway plants are now operated. Engine No. 1 is thus driving generator No. 1 directly connected, without any wearing parts except the bearings of the two machines. In case it becomes necessary to drive generator No. 2 from engine No. 2 bolts S are inserted as shown, thus rigidly connecting disc H to disc F and revolving shaft E. The bolts S can be reversed so that disc F will be rigidly bolted to disc J, permitting shaft E to drive generator No. 1 from engine No. 2, thus performing all the functions of the magnetic clutch as described above.

Fig. 1*b* is another form of clutch now commonly used in cable railway plants. The disks H and J are keyed to the engine and generator shafts respectively, and disc X is keyed to shaft E. If it be desired to drive generator No. 2 from engine No. 2, two steel or wrought iron keys are inserted in recesses U U, thus rigidly connecting the disc H to disc J. By inserting the wedges in recesses V V, shaft E is made to revolve from engine No. 2 and by inserting the wedges in recesses W W generator No. 2 is caused to revolve from shaft E, thus making the plant interchangeable in all directions.

The entire plant is mounted upon a cast-iron bed-plate cast in sections and thoroughly anchored, just as in first class cable railway power station construction of the present day. The system is especially applicable to arc lighting stations where, as it is well known, a large number of small electrical units must be used, owing to its being usually necessary to run a machine for each arc light circuit. When it is desired to start any generator, it is brought up to speed as a motor, and when it attains the same speed as the line shaft, a positive clutch, operated either by hand or by electricity, is thrown into connection, after which the current is reversed through the machine and it immediately becomes a generator.

It will thus be seen that any generator in the plant can be started and stopped at will, without stopping either engine, or without using belts, pulleys or friction clutches, thus having all the flexibility and reliability of the ordinary low speed lighting station, wherein shafting and belting are used, and occupying not over one-quarter the amount of ground that such a plant ordinarily covers. This permits a very much less extensive building to be constructed, less investment in real estate; greater ease in operation, on account of having fewer wearing parts to lubricate and to maintain, and less labor to operate the plant.

Another important feature is that any kind of moderately speeded engines or generators can be installed under this system without any radical change in design. This would enable many of the older plants to be rebuilt, utilizing a large portion of their present equipment. The arrangement here described is the design of Mr. B. J. Arnold, of the Rookery Building, Chicago.

LEGAL NOTES.

JUDGE RICKS AGAIN REFUSES TO GRANT AN INJUNCTION AGAINST THE BUCKEYE CO.—THE EDISON ELECTRIC LIGHT CO. AND EDISON GENERAL ELECTRIC CO. vs. THE BUCKEYE ELECTRIC CO.

ON May 4, as noted briefly in our last issue, Judge Ricks of the U. S. Circuit Court at Cleveland, O., handed down an opinion maintaining his former decision and refusing to grant a preliminary injunction against the Buckeye Electric Co. After the original decision of Judge Ricks, the General Electric Co. made another application submitting new affidavits in support of their motion which set forth that in making the application to the Patent Office in October, 1883, asking for a limitation of the life of the patent, Edison acted without the authority or knowledge of those who were associated with him in the Edison Lamp Co., to whom the sole rights to manufacture the incandescent lamp had been transferred. While giving due credence to these affidavits, Judge Ricks holds that because of their intimate associations in the enterprise, they must have learned of that proceeding soon after it took place, and that they have since ratified the acts of their associates in different ways. Judge Ricks says:

> "If they (Edison's associates) considered their interest in the contract of 1881, as valuable from October, 1883, to March, 1893, as they do now, they were bound to protect it by such acts and conduct as not to mislead those dealing with this patent, and with its inventor and owner. With the certificate of correction attached to every copy of the Edison patent issued between October, 1883, and March, 1893, and with the concern that existed as to the effect of the Patent Office proceedings upon all interested in the patent, it seems highly improbable that during all that period these associates of Edison remained in ignorance of what had been done. If they were so innocent and ignorant during that time, it ought to so affirmatively appear, for it is the fact most important in view of the decision of the Court dissolving plaintiff's injunction allowed upon the original hearing. Having failed to make this full and explicit denial, I am warranted, in view of all the facts, in concluding that these associates of Edison did acquire the knowledge of this Patent Office proceeding during the period named. * * * Having knowledge of the part taken by their associate, Edison, in the Patent Office proceeding, they were charged with the knowledge of its legal effect on their rights under the contract of 1881, and they were charged with the duty of protecting them by their subsequent acts and conduct.
>
> The motion for a preliminary injunction is therefore refused."

INCANDESCENT LIGHTING DISTRIBUTION PATENTS.—EDISON E. L. CO. vs WESTINGHOUSE ELEC. MFG. CO. AND N. Y. INS. WIRE CO.

A SUIT has been instituted in the United States Circuit Court on behalf of the Edison Electric Light Company against the Westinghouse Electric and Manufacturing Company and the New York Insulated Wire Company, to recover royalties for alleged infringement of patent No 264,642 issued in September, 1882, for improvements in the electrical distribution system of incandescent lighting from central stations.

The patent was applied for by Thomas A. Edison in 1880 and granted two years later. In the meantime, according to the bill of complaint, the patentee transferred his interest in the patent to the Edison Electric Light Company.

The answer filed by the Westinghouse Company, denies the right entirely of the Edison Company to the patent. It was old and well-known, the answer states, prior to any invention or discovery thereof by Edison, and involved merely the exercise of ordinary engineering skill and judgment. Moreover, it is further alleged that the transfer of the patent by Edison to the Edison Company was not registered in the patent office until 1838.

LITIGATION OVER ELECTROLYTIC RAILWAY CURRENTS.

THE CARLISLE (PA.) GAS AND WATER COMPANY recently asked for an injunction restraining the Carlisle Traction Company from laying their tracks above the water mains because of electrolysis. The case was argued May 2 and Judge Sadler said, as it is an important issue that involves millions of dollars of property throughout the country, it must be fully investigated. The case was continued so that the railway company may take testimony.

STORAGE BATTERY LITIGATION.—CONSOL. ELEC. STORAGE CO. vs. ELEC. STORAGE BATTERY CO.

THE argument on the motion for injunction made by the Consolidated Electric Storage Co. against The Electric Storage Battery Co. came on for hearing before Judge Green, at Trenton, on Tuesday, the 8th inst. It will be resumed on May 29th.

REPORTS OF COMPANIES.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO. ANNUAL REPORT.

SUBJOINED is the full report of the Westinghouse Co. dated May 16, to its stockholders:—

Notwithstanding the fact that there was a general paralysis in industrial affairs throughout the United States during the last nine months of the past fiscal year, your Board is able to present herewith a financial statement for the year ending March 31, 1894, which it believes will prove satisfactory in every particular.

From the balance sheet it will be noted that the net profits from manufacturing and other sources amounted to $1,640,809.11 after charging to operating expenses, as heretofore, large sums for alterations and additions to buildings, for maintaining the machinery and tools in the highest order, and all sums paid for interest and discount, excepting interest on bonds and scrip, which has been charged off direct to surplus.

It will be seen that a large reduction in accounts payable, bills payable issued for merchandise, and those discounted with collateral has been made from the profits of the company, which further illustrates the careful manner in which the officers of your company have conducted its business. By the recent sale at par of the preferred stock which was in the treasury of the company, the bills payable have been further reduced since the 31st of March, so that on May 9th there were outstanding only $560,982.64 of bills payable of all kinds, of which $37,869.04 were issued for merchandise.

WORLD'S FAIR LIGHTING CONTRACT AND EXHIBIT.

All of the apparatus used in connection with the World's Fair lighting contract and for exhibition purposes has now been returned to the warehouses of the company, and the final payments have been made by the World's Columbian Exposition Company.

The amount of the contract for lighting was $399,000 and for extras under the contract $88,704.47, making the total received by the company $487,704.47. All goods shipped to the Fair were charged at the cost of labor and material with 20% added. After charging the account with all costs of every nature in connection with the running of the plant and of the exhibition, and crediting it upon the return of the material with the net cost of labor and material, it shows a net cost to the company of only $16,018.03 for a grand display of the company's apparatus, the advertising effect of which has been invaluable. The price at which the lighting apparatus used at the World's Fair, and the apparatus used for exhibit has been sold, will yield a handsome profit to the company.

It is gratifying to state in connection with this subject that the entire contract was carried out without friction of any character, and without a single deduction of any kind being made from the bills rendered by the company, and that the experience gained by the company in constructing such large apparatus was an important factor in the securing of the contract for the three 5,000 horse-power generators now being constructed for the transmission of power from Niagara Falls for the Cataract Construction Company.

NIAGARA FALLS POWER TRANSMISSION.

The awarding to your company by the Cataract Construction company of the contract for three 5,000 horse-power generators for the transmission of the power of Niagara Falls to Buffalo and other points was an event of more than ordinary importance. The officials of the Cataract Construction Company had employed the most renowned electrical engineers of the world, and had spent some years in a full investigation of the subject, and finally contracted with your company bec use of a belief in its ability to successfully carry out such an important undertaking The transmission of power by means of these generators involves the use of your company's Tesla patents covering the system of multiphase motors, and therefore the successful starting of this plant cannot fail to have a great influence in the development by your company of other plants for the transmission of power from waterfalls to remote points, by reason of the experience gained in this instance, and by reason of the ownership of the controlling patents. The three generators contracted for will soon be completed and put in operation.

INCANDESCENT STOPPER LAMPS.

The successful use at the World's Columbian Exposition of the stopper lamps manufactured by your company, and their large use in general lighting, have fortunately placed the company in a position to protect all of its customers from the aggressive action of the owners of the Edison patent covering the all-glass globe form of lamp. A steady advance has been made in the method of manufacture, so that your company is to-day producing a lamp which has no superior, and the use of which your officers expect to extend with great rapidity during the coming season on account of its quality and low cost of manufacture.

It may be fairly stated that the peculiar methods pursued by the owners of the Edison patent in their efforts to obtain a monopoly of the sale of incandescent lamps have resulted in a disastrous failure, for the price of incandescent lamps to the public at large has been greatly reduced in consequence of the success of your company in the production of non-infringing lamps. Your officers believe that they will be able to sell stopper lamps to the company's customers at a price not exceeding the manufacturing cost of the all-glass form, and thereby greatly promote the company's electric lighting business.

COMPETITION AND PATENTS.

Our competitors have continued to copy our plans and infringe many of our patents, and in one instance the company's officials were reluctantly compelled to have indicted and arrested the agents of a large corporation who had entered into a conspiracy and had thereby succeeded in robbing your company of valuable drawings and information. It is believed that the action of your officers in this matter will have the effect of preventing the unlawful appropriation of your drawings and other information in the future.

NEW WORKS.

In the last annual report your directors announced that they had accepted a proposition of the East Pittsburgh Improvement Company to erect, according to the plans of your company, a new manufactory upon a site of 23 acres. In consequence of the general depression in business, the letting of the work was deferred until January, when contracts were awarded at very low rates for the erection of a two-story machine shop 750 feet long and 230 feet wide, a two-story warehouse 750 feet long and 75 feet wide, and a boiler and power house, the whole having a floor space of over ten acres. To these buildings there will be added in time a foundry, blacksmith shop and one or two other unimportant buildings, making the whole plant when completed a most comprehensive one in every respect. The above buildings will be of steel and brick, arranged with reference to the manufacture of modern electrical apparatus of the heaviest character, and will be so equipped with electric cranes, machinery and improved machine tools as to enable the company to manufacture its product so much below the cost in existing competing establishments that the company will, at the prevailing competitive prices enjoy a very satisfactory margin of profit.

Pittsburgh is exceptionally well located with reference to the material required for the construction of electrical machinery, and has unrivaled facilities for the shipment of freight in all directions; and being centrally located with reference to the consumption of electrical apparatus, your officers have full confidence in their ability to secure enough work at profitable rates to fully occupy the entire establishment.

In conclusion we call especial attention to the exceptionally favorable position of your company with respect to the electrical trade. Its capital stock in proportion to its operations is small, and it has no contracts of any character with local lighting or other companies which can in any manner interfere with the sale of its apparatus. It has a harmonious management, and has an unequaled reputation with respect to the design and character of its apparatus; so much so that the company's standard apparatus is purchased and paid for without special guarantees of any kind.

The new works of the company will be completed and occupied during the present year, so that all of the manufacturing will be concentrated and large savings thereby effected.

For the Board,

GEORGE WESTINGHOUSE, JR.,
President.

WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.

Balance Sheet, March 31, 1894.

Assets.

Cash in Banks	$325,694.55
Bills Receivable	873,445.51
Accounts Receivable	2,845,161.20
Material in stock and in process of manufacture (at cost of labor and material)	1,545,472.22
Advances to leased companies	109,124.68
Bonds (par value, $249,800)	237,397.15
Stocks (par value, $6,489,490.16)	3,988,992.26
Real Estate and Buildings	464,403.48
Machinery and Tools	886,452.67
Miscellaneous	66,339.07
Charters, Franchises, Patents, etc.	4,379,831.69
Total Assets	$14,722,814.48

Liabilities.

Accounts payable			$311,749.75
Bills payable, issued for Merchandise			116,983.85
Discounted with collateral			697,300.00
CONTRACT AND CONTINGENT LIABILITIES.			
Scrip dividend			194,560.00
Stock subscriptions			18,125.00
U. S. E. Ltg. Co.'s 6 per cent. 15 year bonds, $50,000 payable annually			550,000.00
(Bills receivable under discount, $528,550.65.)			
CAPITAL STOCK.			
Preferred, 73,439.31 shares		$3,671,965.50	
Assenting, 103,309.62 shares		5,165,481.00	
Common, 3,583 shares		179,150.00	
			9,016,596.50
(In Treasury 6,560.69 shares Preferred; and 13,107.38 shares Assenting.)			
Surplus.			
Balance, March 31, 1893		$2,757,649.19	
Twelve months net earnings from business	$1,610,504.66		
From other sources	30,304.45	1,640,809.11	
		$4,398,458.30	
Less amount written off in adjustment of matters pending in 1890 and 1891	$19,198.78		
Ditto in current year	252,323.20	271,521.98	
		$4,126,936.32	
Interest on Bonds	$36,000.00		
Interest on Scrip	11,673.72		
Dividends	257,213.22	304,886.94	3,822,049.38
			$14,722,814.48

BERLIN IRON BRIDGE COMPANY.

THE BERLIN IRON BRIDGE COMPANY paid on April 14th, their regular quarterly dividend of 1½ per cent. Considering the hard times in all branches of business, especially among manufacturers of structural iron, this shows pretty good management—not to put it any stronger, and is a refreshing change from reports coming from so many quarters, of closed factories and "passed" dividends.

PERSONAL.

MR. G. J. MELMS, formerly of the Milwaukee electric light and railway plant, recently described in THE ELECTRICAL ENGINEER, has been appointed technical director of the municipal light and railway plant at Frankfort, Germany.

MR. OSCAR T. CROSBY has been suffering from a serious attack of nervous prostration due to overwork attendant upon closing up his affairs as Railway Manager for the General Electric Co. and assuming his new duties with the White-Crosby Co. It is encouraging to learn, however, that Mr. Crosby is making rapid recovery of health, and may soon again be seen at his offices in the Columbia Building, Broadway.

COLLEGE NOTES.

NATIONAL SCHOOL OF ELECTRICITY.

FINAL charter papers have just been granted at Springfield, Ill., to the National School of Electricity, an organization growing out of the electrical department of the World's Fair. Prof. Barrett, chief of the electrical department of the World's Fair and chief electrician of Chicago, is at the head of the organization, and Mr. Thomas A. Edison heads the faculty of education.

The faculty is made up as follows: Mr. Edison, dean; Mr. Nikola Tesla; Dr. Gray, of Highland Park; Prof. Carhart, of Ann Arbor; Prof. Anthony, of New Jersey; Prof. Ryan, of Cornell; Prof. Perrine, of Leland Stanford, Jr. University; Prof. Shephardson, University of Minnesota; Prof. Thomas, University of Ohio; Prof. Jackson, University of Wisconsin; Prof. Ayres, University of Louisiana; Prof. O'Dea, University of Notre Dame, and Prof. Barrett.

It is the intention of the founders of the school to inaugurate classes in electricity in every city and town where the population will justify it.

UNIVERSITY OF WISCONSIN.

WE have just received the announcement for 1894–5 of the College of Mechanics and Electrical Engineering and the University of Wisconsin, in which we note the increasing attention given to electrical work, not only by under-graduates but also in the graduate courses. The electrical engineering course, in charge of Prof. Jackson and Prof. Davies, promises a complete curriculum of dynamos, applied electric chemistry, comprising primary and secondary batteries, electric light, transmission of power, railways and electrical testing and including instruction in station management. The mathematical study of electricity and magnetism is by no means neglected, and laboratory work is made to conform with and illustrate class-room instruction. Indeed, of the total number of hours given to instruction in the electrical engineering course about one-half is devoted to work in the laboratories.

THE LELAND STANFORD, JR., UNIVERSITY, CALIFORNIA.

AMONG the numerous courses open to students at this University, that of electrical engineering has already taken a prominent place, under the direction of Prof. Perrine, assisted by Prof. Olivette. The course includes instruction in constructive material of machinery directly applicable to electric light, railway, power transmission and telegraph work; the elements of dynamo machine design, central station design and management; and special attention is devoted to practice in planning electrical plants and the solution of electrical problems. The graduate course, designed for those who wish to fit themselves for any special work, comprises instruction in the history and practice of inductive apparatus and dynamo design, telegraph and telephony and special applications in electricity.

SOCIETY AND CLUB NOTES.

AMERICAN STREET RAILWAY ASSOCIATION.

The following is a list of the subjects and special committees appointed to report thereon, at the Thirteenth Annual Meeting of the American Street-Railway Association, to be held in the City of Atlanta, Ga., October 17–19, 1894.

Can the T Rail be Satisfactorily Used in Paved Streets? Joel Hurt, Pres., Atlanta Consolidated St. Ry. Co., Atlanta, Ga.; S. Hendrie, Manager, Wyandotte and Detroit River Ry. Co., Detroit, Mich.; H. J. Crowley, Engineer, Atlanta Consolidated Street Ry. Co., Atlanta.

City and Suburban Electric Railways. Elwin C. Foster, Supt., Lynn and Boston R. R., Boston, Mass.

Mail, Express and Freight Service on Street Railway Cars. Richard McCulloch, Elec. Eng'r., Citizens' Railway Co., St. Louis, Mo.

The Best Method of Treating Accidents and Complaints. John B. Parsons, Genl. Magr., West Chicago Street R. R., Chicago, Ill.

Street Car Wheels and Axles. D. S. Cook, Elec. Eng'r., Trenton Pass. Ry. Co., Trenton, N. J.

Transfers and Commutation. Rodney Curtis, Pres., Denver Tramway Co., Denver, Col.

The T Rail Construction of the Terre Haute Street Railway Co., M. F. Burke, Supt., Terre Haute Street Railway.

A Standard Form for Accounts for Street Railways. H. I. Bettis, Cons. Eng'r., Atlanta Cons. St. Ry. Co., Atlanta, Ga.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS, OF ENGLAND.

We have received the rules, list of members, etc., of the new Northern Society of Electrical Engineers, which has recently been started at Manchester, England, with Dr. John Hopkinson as president, Messrs. G. E. Preece, Henry Edmunds, and W. P. James Fawcus, vice-president, and Mr. John Darney, hon. secretary. The society has already more than one hundred members and is doing excellent work.

MR. HADAWAY ON "ELECTRIC HEATING" BEFORE THE NEW YORK ELECTRICAL SOCIETY.

A VERY interesting and valuable paper on "Electric Heating from the Engineering Point of View," was read by Mr. W. S. Hadaway, Jr., before the New York Electrical Society, at Columbia College, on May 10. The paper was illustrated by a well selected display of apparatus loaned for the occasion by the Central Electric Heating Co. and utilized by a cook and a laundryman. The data given by Mr. Hadaway proved very suggestive to electricians, while the apparatus aroused the curiosity and envy of the numerous ladies in the audience.

LETTERS TO THE EDITOR.

STORAGE BATTERY TESTING.

Without wishing in any way to criticise Mr. Lloyd's excellent and timely paper in THE ELECTRICAL ENGINEER of April 25th, the writer desires to add a few statements in connection with this subject, as the results of his personal experience. The item of annual cost may be disposed of without the necessity of testing as Mr. Lloyd suggests, for reliable manufacturers are now prepared to guarantee the maintenance of their plates at a fixed sum, or percentage of the first cost, annually. These manufacturers very properly insist on installing automatic devices with their accumulators, so designed as to prevent the exceeding of a pre-determined rate of charge and discharge, thus saving the plates from abuse in this direction.

The industry is now sufficiently advanced to furnish reliable data on the cost of maintenance in all conditions of work, and from these reports, and not a laboratory test, should this item be estimated. Until purchasers learn to look more at the advantages than the first cost of accumulators, the general introduction of these much-abused but highly useful devices will be greatly retarded, and the same fact is true with respect to the attitude of the majority of electrical engineers to accumulators, many of these gentlemen at present simply remarking that accumulators are "no good," and refusing even to consider the subject.

The difference between the manufacturers' rated capacity per element and that actually obtainable, is a point well worthy of careful attention. Under the most favorable conditions, very few of the various accumulators encountered in my experience will come up to maker's rating, and even if this capacity is obtained, it cannot be retained.

The practice of working between narrower voltage limits of charge and discharge is undoubtedly very excellent and desirable, insuring as it does, more simplicity of regulation, and better life for the plates, but an equivalent ampere capacity in these limits means a much larger first cost, a fact likely to prove a serious objection to the general introduction of this method of engineering, due to reasons previously referred to in this article, viz., that the first cost is at present almost the only point given consideration.

FREDERICK L. MERRILL.

CHICAGO, May 5, 1894.

LITERATURE.

Recenti Progressi Nelle Applicazioni Dell'Elettricita. By Rinaldo Ferrini. Milan, 1894. 2d Edition, 2 Vols. Ulrico Hoeple. 808 pages, 6¼ x 9 inches. Price, $5.

THIS work is designed to give the reader an idea of the principal applications of electricity at the present time. The first volume is occupied almost exclusively with the dynamo, in which the author enters quite fully into the mathematical discussion of the methods employed in its construction. Volume 2 takes up the description of transformers, motors, etc., and their application in the distribution and transmission of power, including electric railways. Among the latter chapters we note descriptions of American apparatus, but are somewhat disappointed in the illustrations, which show types now considerered somewhat out of date, at least in this country. The final chapters treat of electric heating as applied to welding, and of electric smelting.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 8, 1894.

Accumulators :—

Electric Accumulator or Secondary Battery, A. J. Smith, London, Eng., 519,482. Filed July 20. 1893.

The method of manufacture consists in repeatedly coating a metal plate with the metallic oxide and kneading the latter into the metal by means of pointed rods.

Storage Battery Plate, C. P. Elleson, London, Eng., 519,602. Filed Oct. 26, 1893.

Employs a plate composed of sheets of corrugated metal perforated throughout their entire surfaces and arranged with their corrugations crossing one another at an angle.

Alarms and Signals :—

Electric Fire Alarm Transmitter, A. Dunish, Ravenna, Ohio, 519,497. Filed Jan. 16, 1894.

Electrical Temperature Annunciator, E. Kloss, Stettin, Germany, 519,634. Filed Dec. 22, 1893.

Distribution :—

Alternating Current Transformer, C. S. Bradley, Avon, N. Y., 519,376. Filed Mch. 15, 1892.

Employs a closed coil winding connected with the several wires of a polyphase circuit, and a closed coil secondary winding tapped at two opposite points for connection with the distribution circuit.

Generating and Utilizing Electric Currents of High Potential, C. S. Bradley, Avon, N. Y., 519,377. Filed Nov. 10, 1892.

Employs a multiplicity of direct current generators located at a series of stations distant from one another, each highly insulated from earth and having a local generator for exciting its field magnet circuit, the frames of both the generator and exciter being electrically connected with a brush of the former.

Dynamos and Motors :—

Method of Operating Electric Motors, J. S. Bancroft, Philadelphia, Pa., 519,686. Filed Dec. 15, 1892.

Claim 1 follows :—

Two or more motors, a source of current for the motor fields, a reversing switch for the armature circuit of each motor, a rheostat that controls the the potential of the armature current and means for interlocking the actuating parts of the reversing switches with the actuating part of the rheostat.

Galvanic and Thermo-Electric Batteries :—

Galvanic Battery, C. W. A. Hertel, Berlin, Germany, 519,330. Filed July 14, 1893.

Employs a zinc electrode consisting of a sheet of zinc wound spirally and having glass rods passing through it to hold it in position and insulate it.

Lamps and Appurtenances :—

Carbon Holder for Arc Lamps, E. Lavens, Brooklyn, N. Y., 519,334. Filed Sept. 30, 1893.

Metal Working :—

Electric Welding Machine, H. Lemp & C. G. Anderson, Lynn, Mass., 519,836. Filed May 26, 1891.

Employs a cut off for controlling the flow of current in the primary of the transformer and a controlling magnet in the secondary circuit independent of the circuit through which the heating current flows.

Miscellaneous :—

Reactive Coil, H. Lemp, Lynn, Mass., 519,835. Filed Nov. 21, 1889.

Consists of two adjustable coils in inductive relation to one another on an iron core, one coil being divided into sections and provided with connections to a switch whereby its conductivity and reaction may be changed without varying the total number of windings in action.

Safety Water Column, H. Engel, Cleveland, O., 519,382. Filed Feb. 9, 1894.

Employs an electric bell and circuits adapted to sound a high and low water alarm.

Electrolysis, H. Blumenberg, Jr., Mount Vernon, N. Y., 519,400. Filed May 6, 1893.

Electrodeposition of Metals, H. Thofehrn, Paris, France, 519,595. Filed June 20, 1893.

Electromagnetic Tool, C. F. Carpenter, Louisville, Ky., 519,662. Filed June 20, 1891.

An electric drill operated by a solenoid and plunger.

Railways and Appliances :—

Contacting Device for Electric Railways, D. F. Graham, Springfield, Ohio, & W. P. Allen, Chicago, Ill., 519,828. Filed Oct. 25, 1893.

A contact shoe especially designed for use with underground conduit railways.

Conduit Electric Railway, J. F. Cook, Mansfield, Pa., 519,380. Filed Feb. 5, 1894.

Relates to certain details in relation to the supporting of the trolley wire and the arrangement of the contact device.

Trolley Wire Hanger, A. B. Crounse & C. A. Rutledge, Passaic, N. J., 519,446. Filed July 21, 1893

Trolley Wire Crossing, E. H. Allen, Cramer's Hill, N. J., 519,519. Filed Feb. 2, 1894.

Trolley Wire Hanger, C. F. Strassburg, Lincoln, Neb., 519,631. Filed Aug. 31, 1893.

Electrical Propulsion of Railway Cars, J. J. Heilmann, Belfort, France, 519,674. Filed Dec. 18, 1890.

Employs motors mounted concentrically upon the axles of the truck and supplied with current from a generator driven by a steam engine carried by the locomotive itself. (See THE ELECTRICAL ENGINEER, May 17, 1893, and March 21, 1894.)

Switches and Cut-Outs :—

Electric Switch, J. F. McElroy, Albany, N. Y., 519,338. Filed Aug. 2, 1893.

A cylinder switch especially adapted to controlling currents used for electric heating.

Telegraphs :—

Apparatus for Telegraphic or Telephonic Transmission, M. I. Pupin, New York, 519,346. Filed Dec. 14, 1893.

Employs a circuit divided into sections disposed in inductive relation and in series, having the various sections tuned to a selected periodicity by the interposition of a capacity or capacities large in comparison with the distributed capacity of the sections.

Transformer for Telegraphic, Telephonic, or Other Electrical Systems, M. I. Pupin, New York, 519,347. Filed Feb. 10, 1894.

Claim 1 follows :

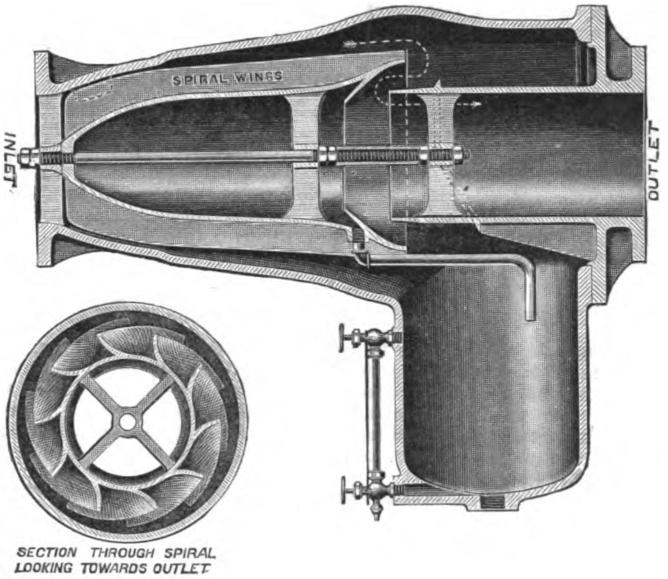
A transformer having one of its coils divided into sections, the said sections being connected in series and in electrostatic inductive relation, and each section being tuned to a certain predetermined periodicity.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

"THE SPECIAL" DE RYCKE CENTRIFUGAL GREASE EXTRACTOR.

THIS is an improved form of the well-known De Rycke grease extractor, and consists of a shell or casing in which there is firmly secured a hollow bell-shaped cone, which overlaps the inverted outlet pipe, which makes it impossible for any grease to escape into the condenser. The cone has knife-edged spiral wings as shown in section in Fig. 1. The annular space between the shell and cone at its smallest cross section is equal to the diameter of the exhaust pipe from whence it is greatly enlarged. The annular space between the cone and the outlet pipe is also largely in excess of the area of the exhaust pipe.



FIGS. 1 AND 2.—"THE SPECIAL" DE RYCKE CENTRIFUGAL GREASE EXTRACTOR.

On entering the extractor the exhaust steam is spread and thrown outward by the cone and given a centrifugal motion by the spiral wings. At the end of the cone the motion of the exhaust steam is reversed as shown in Fig. 2, and the heavier particles are thrown to the outward end of the shell of the extractor, and into the interior of the cone from whence they are carried off by a pipe into a tank specially arranged to meet the requirements of condensing engines.

The spiral cone is cast in chills giving it a hard and extremely smooth enamel-like surface, thereby preventing friction or any obstruction to the free outward flow of grease or other foreign matter in its separation from the steam. It is stationary, being prevented from revolving by lugs cast on the interior of shell of the extractor.

The De Rycke centrifugal grease extractors are in use in the great River Street Power House of the Milwaukee Street Railway Co., described in THE ELECTRICAL ENGINEER of March 14, 21 and 28, and the following testimonial letters require no further comment:

MILWAUKEE, April 28, 1894.

JOSEPH DE RYCKE, Esq.,
145 Broadway, New York.

Dear Sir :—Complying with your request as to the number of steam separators and extractors in use in this station and the length of time they have been in use, I desire to say that we are using five 6-inch separators and five 12-inch extractors in the lighting plant for the past year. I have no hesitation in recommending them from the very satisfactory results we have achieved from them in this station.

Yours very respectfully,
(Signed) W. H. CRAWFORD,
Mechanical Engineer.

MILWAUKEE, April 21, 1894.

JOSEPH DE RYCKE, Esq., Consulting Engineer,
145 Broadway, New York.

Dear Sir :—I beg to comply with your inquiry as to the efficiency of the De Rycke extractors and separators in use in this station. We have nine extractors and nine separators installed in our power house and they are doing the work very satisfactorily and with good results; I have no hesitation in recommending them.

Yours very truly,
(Signed) R. S. STIKEMAN,
Supt. of Construction.

MR. JOSEPH DE RYCKE, 145 Broadway, this city, is the patentee and sole manufacturer of this new extractor, and will be pleased to furnish any further information desired by our readers concerning it.

SALES OF ELECTRIC LAUNCHES.

THE GENERAL ELECTRIC LAUNCH Co., of Morris Heights, New York, sold four of their launches last week: One to Lord Aberdeen, Governor-General of Canada, for use at Ottawa; two to A. Meinecke, Jr., of Milwaukee; and one to the Altoona & Logan Valley R.R. Co., for use at Altoona.

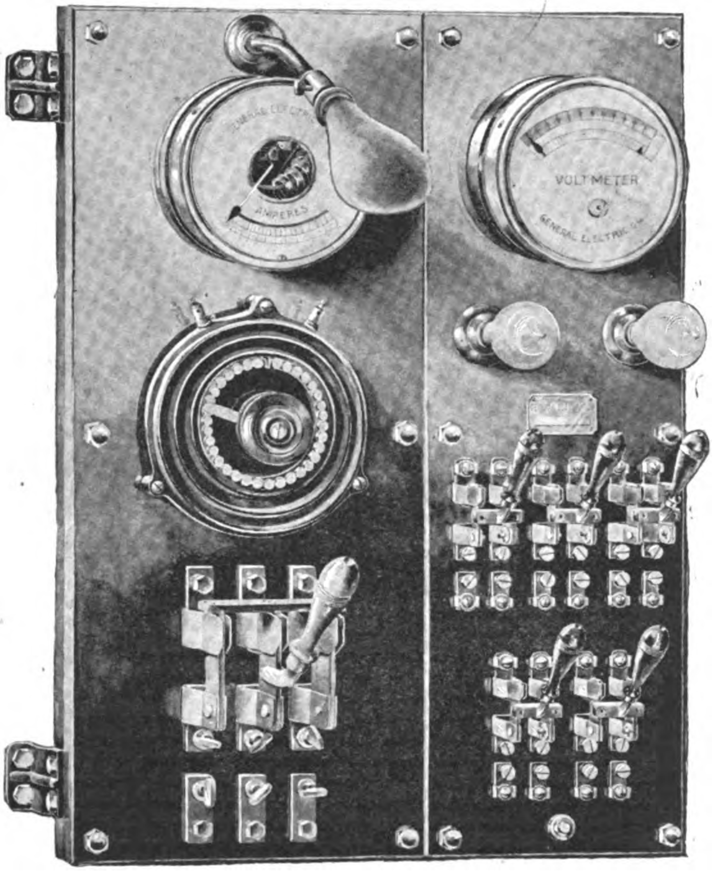
ELECTRIC SELECTOR AND SIGNAL CO.

This company makes a specialty of its Electric Light and Power Controller, a device to control absolutely the output of current to any individual lamp or motor or any group of lamps or motors, starting lamps and extinguishing them from the central light and power station, and from the same station regulating the hours the motors are to be operated. The apparatus now offered is said to be extremely simple in construction, not apt to get out of order, and to fill a long-felt want in electric light and power fields.

Mr. P. H. Alexander, whose qualifications and activity are well known in electrical circles, has been appointed manager of the Light and Power Department of the Electric Selector and Signal Company. The address is 45 Broadway, New York.

NEW GENERAL ELECTRIC SWITCHBOARD.

MUCH ingenuity has been expended on the improvement of the switchboard to bring it down to convenient proportions and yet to have upon it all the necessary instruments within easy reach of eye and hand. We show one of superior convenience lately designed by the General Electric Company for isolated plants. The complete board comprises a panel for each generator and one for each set of five feeders. The generator panel is equipped with newly designed switches of high conductivity and durability, each of which has its own fuse holder. The rheostat and amperemeter are of the latest and most compact type. Each feeder panel carries an improved voltmeter and two-lamp ground detector, the push button being shown in the lower part of the panel.



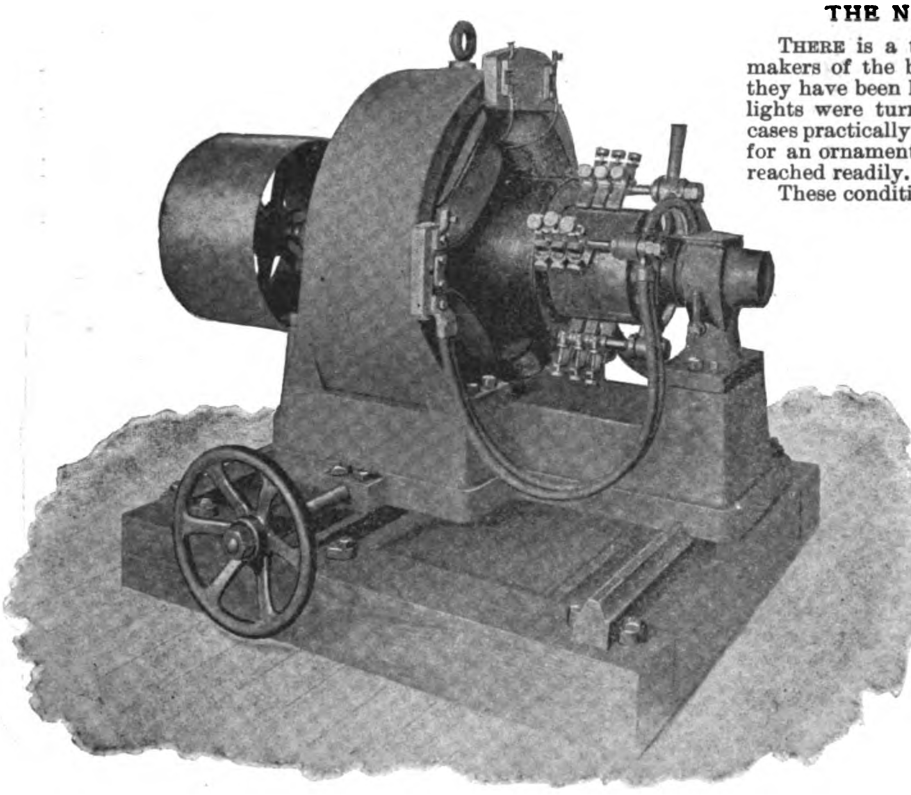
NEW GENERAL ELECTRIC SWITCHBOARD.

The advantage of this arrangement of switchboard lies in the possibility of uniformly enlarging the board by merely adding panels. They can be set side by side and be connected with tie bars, and are furnished ready for installation and receipt of the generator and feeder connections.

NEW RIKER MULTIPOLAR DYNAMO.

The dynamo shown in the accompanying illustration has just been placed upon the market by the Riker Electric Motor Co., of 45–47 York street, Brooklyn. As ordinarily constructed this machine is designed as an incandescent generator working at the standard pressure of 125 volts. The base is made of cast iron, very heavy and thoroughly braced to prevent the springing of the bearings. The field magnet is built of cast steel with salient poles projecting radially inward. In sizes up to and including 20 K. W. high speed and 6 K. W. low speed, the field is cast in one piece, while in larger sizes the field is split to facilitate the handling of the armature. The section of the poles in all machines of this type is square, thus permitting a minimum length of wire to surround a maximum section of iron without the necessity of making separate cores and pole pieces, as is the case in round core magnets of this general description. The field coils are wound on heavy metallic thimbles or spools which serve the double purpose of holding the coils securely in place and by their action as closed secondaries, absorbing the destructive induction sparks that result from breaking the field circuit.

All these generators are compound wound to maintain practically constant potential, a slight rise of one or two per cent. being allowed to compensate for a fall in engine speed.



New Riker Multipolar Dynamo.

The armature is of the drum type, the plates being mounted directly upon and keyed fast to the shaft. The plates are clamped between heavy cast iron flanges which are threaded on the shaft. No bolts pass through the core plates, thus obviating the trouble and expense of extensive insulation in the armature. The wires are laid in milled grooves, and all insulation on the armature between the core and the wire is either micanite cloth or pure mica. The coils of these armatures are all cross-connected in parallel grouping, in order that the electrical balance shall be maintained even when one or two sets of brushes are removed. The commutator is very heavily built, the bars being clamped between steel cones and insulated throughout with mica.

While the machines run without undue heating, they are not built unnecessarily heavy, a good wide working margin being allowed. The armatures under long runs at full load are allowed to rise in temperature about 40 to 50 degrees F. above that of the surrounding atmosphere. A rating of 500 circular mils per ampere at full load is allowed in all armatures, while in the shunt and series coils 1,000 circular mils is the rating. All resistances are kept as low as possible, thus reducing internal waste and maintaining efficiency.

All the fittings and connections of these dynamos have been designed to facilitate installation and at the same time to present an artistic appearance. The machines are thoroughly high grade both as regards build and performance, and in every particular embody the principles of the best modern practice. From a theoretical point of view they are designed to a nicety, due regard being had for practical consideration. The company is now prepared to furnish this type of machine in sizes from 10 to 100 K. W.

THE ST. LOUIS IRON & MACHINE WORKS.

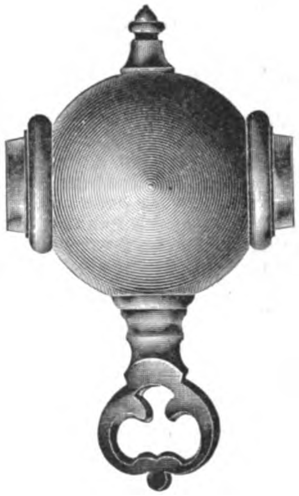
A profusely illustrated catalogue descriptive of the St. Louis Corliss engine has been issued by the St. Louis Iron & Machine Works, of St. Louis, Mo. The various essential parts of the engine are clearly treated in detail, and its many strong points brought out in a forcible manner. The last page contains a closely printed list of some of the companies and individuals using this make of engine, containing well known names of prominent manufacturers in all parts of the country.

THE H. W. JOHNS MFG. CO.

Under the title of "Insulation" the H. W. Johns Mfg. Co., of 87 Maiden Lane, N. Y., has issued a neat little catalogue of 32 pages devoted to the well known moulded mica, "Monarch," vulcabeston and asbestos specialties manufactured by the company. Very little space is given to description, as the various devices are so well illustrated that they speak for themselves. The catalogue will be valuable to anyone wishing information in regard to high-class insulating appliances.

THE NEWTON FIXTURE ARM SWITCH.

There is a tendency to turn the lights upward, among the makers of the better class of fixtures. In endeavoring to do this they have been hampered considerably by the fact that when the lights were turned upward, the key of the socket was in most cases practically inaccessible, the design of the fixture either calling for an ornamented socket cover or the key being too high to be reached readily.



Newton Fixture Arm Switch.

These conditions called for a keyless socket and a small switch placed in a handy position in the arm of the fixture. Here another obstacle was met, as no switch of good appearance and of reasonable price was obtainable. The Newton Electric Co., of 89 Cortlandt street, foresaw the want, and got up the switch as shown in the accompanying cut. It is neat and small and fills the bill admirably. The switch makes a clean quick contact or break.

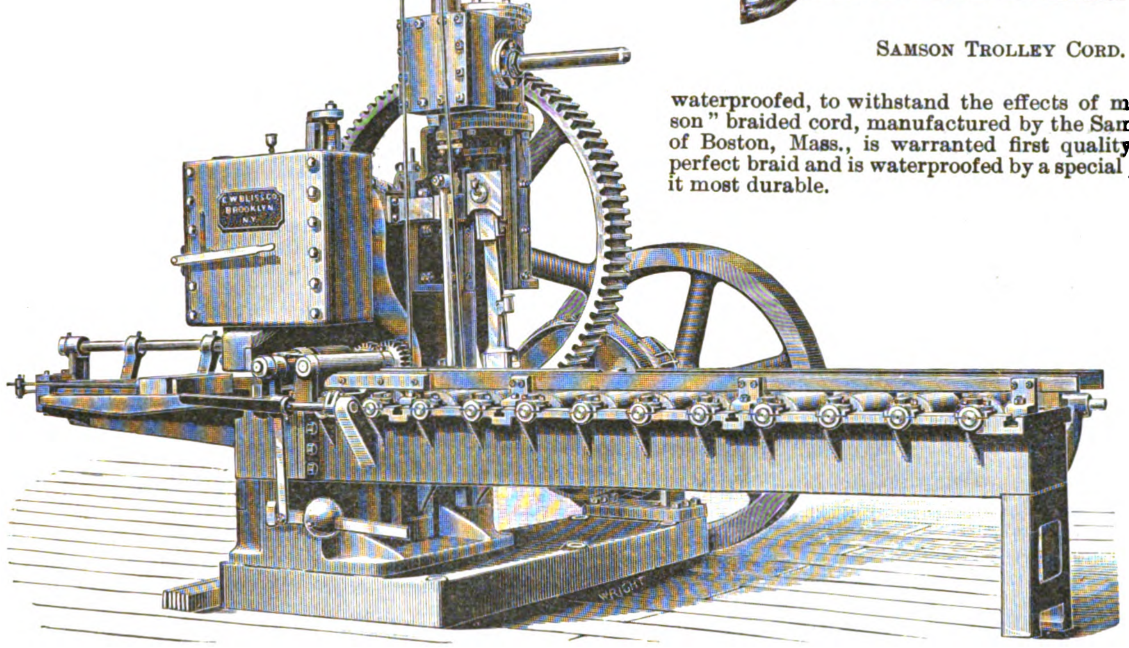
A LARGE STEAM HEATING PLANT TO BE CONSTRUCTED AT SCRANTON, PA.

The Economy Heat, Light & Power Company of Scranton, Pa., has contracted with the American District Steam Co., of Lockport, N. Y., for the construction of a steam heating and power plant, with underground mains (Holly system), to cost one hundred and fifty thousand dollars. The officers of the company are:—Wm. Connell, president; Lemuel Amerman, vice-president; Lieut. Gov. Watres, treasurer; I. H. Burns, secretary.

Brookline, Mass.—The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up a gas house extension for the Brookline Gas Co., at Allston, Mass.

THE BLISS AUTOMATIC MUCK BAR SHEAR.

In the process of rolling steel into thin sheets, it would be impracticable to roll each sheet separately, as it would not retain its heat, and the following method is adopted. A billet of steel of sufficient size to make a large number of sheets is heated and passed a number of times through a train of rolls, each pass lengthening the bar and reducing its size. It leaves these rolls in the form of a bar twenty or thirty feet long and something like an inch thick by eight inches wide, these dimensions depending upon the size and gauge of the sheets to be made. These bars, technically known as the muck bars, are cut up into uniform lengths, and each piece is then repeatedly re-rolled and folded over, each rolling operation reducing the thickness and increasing the linear dimensions; and each folding doubling the number of sheets in the final pack. After the last rolling, the ends of the pack are sheared, leaving each sheet free to be separated. It is very important that the pieces into which the muck bar is cut should be of uniform size, and squarely cut, as upon this depends the size and form of the subsequent pack; and it will easily be seen that any error will be largely exaggerated with the successive passes through the rolls.



Bliss Automatic Muck Bar Shear.

The method heretofore employed for shearing the muck bar has been to carry the bar to the old-fashioned alligator shear, place the end against a fixed gauge, which determined the length of the pieces, and pass the bar along by hand for the successive cuts. This method not only requires the labor of several men to handle the bar, but calls for considerable skill on the part of the shear man, and unless great care is used the results are liable to be unsatisfactory. The accompanying illustration represents a machine designed by the E. W. Bliss Co., of 145 Plymouth street, Brooklyn, N. Y., for doing this work automatically, thus requiring but one man to do the work, who need not be a skilled shearman. The machine consists of a powerful gate shear driven directly by an engine. A clutch is attached to the engine shaft which can be operated either by hand or automatically. To the right of the machine is a carrier composed of a train of rolls driven continuously. The muck bar coming hot from the rolls is placed upon these carriers, which propel it toward the cutters between side gauges which keep it in position at right angles to the shear blades. Just before entering between the cutters a pair of feed rolls take hold of the bar so as to feed it positively. A clamping device is placed in the path of the bar and so arranged with a lever that the progress of the bar may be arrested by the operator. This lever also controls the feed rolls, so that when the clamps are in contact with the bar, the rolls are removed from it and vice versa. This arrangement gives the operator full control over the bar, and he is enabled to bring it into proper position to square off the ragged end, by throwing the clutch into operation by means of the hand lever shown in cut at the front of the cutter housing. When the forward end of the bar has been squared, the operator raises the clamp lever, and the bar feeds forward. An adjustable gauge is placed in its path, and upon striking this its progress is arrested and the clutch is automatically thrown into operation, causing the shear (upper) blade to descend and cut off the first length. As soon as this occurs, the piece drops out, the shear blade ascends to its upper position and stops, while the bar again feeds forward, and the operation is repeated until the bar is all cut to lengths. By this system the bars are cut accurately, and as rapidlo as they come from the rolls.

In order to adapt the machine to the practical requirements of mill work, experiments were conducted for some time by the makers at the mills of the Canonsburgh Iron & Steel Co., and this machine is the outcome of these experiments. There are several of these machines in operation and they are, it is said, performing every duty required of them, to the complete satisfaction of the persons using them.

SAMSON TROLLEY CORD.

Trolley cord is exposed to all sorts of weather, and it is subject to very sudden strains. It is therefore much safer as well as more economical to use the first quality cord and to have it well waterproofed, to withstand the effects of moisture. The "Samson" braided cord, manufactured by the Samson Cordage Works, of Boston, Mass., is warranted first quality, of pure stock, and perfect braid and is waterproofed by a special process which makes it most durable.

Samson Trolley Cord.

In order that purchasers may be able to distinguish at a glance the first quality cord, the "Samson Spot Cord," is furnished, which is the same as the plain "Samson" cord, but marked with a succession of spots of a different color from the body of the cord, as shown in the accompanying illustration.

"SECO" INCANDESCENT LAMPS.

The Southern Engineering Company, of Louisville, report an unusually large sale, considering the season, of their high grade "Seco" lamps, and are shipping them into a large majority of the states. They are the sole agents for the "Seco" lamp and are succeeding in establishing for it an enviable name. The lamps are made in a variety of styles, among them the plain straight filament, the coil or spiral filament, the anchored filament, the "bung hole" and the bell-shaped desk lamp, as well as in all desired voltages, candle powers and efficiencies. They guarantee the "Seco" to give absolute satisfaction and to replace any lamp burning out or proving defective within one hundred hours' use.

Queen & Co., Incorporated, have issued an invitation to the members of the American Institute of Electrical Engineers to visit and inspect their show rooms during the coming meeting of the Institute in Philadelphia.

NEW YORK NOTES.

Mr. Henry Hine, of the Stanley Electric Manufacturing Company, Pittsfield, Mass., was a visitor in New York last week.

Dr. Cary T. Hutchinson has removed his offices as consulting electrical engineer to the new Postal Building.

The Sachs Electric Company, of New York City, has been incorporated. Capital, $20,000; directors, Theodore L. Peters, Charles T. Haviland, and Francis Forbes, New York City.

Mr. A. Stetson, patent expert, etc., has moved his offices to 243 Broadway. He is greatly interested at present in conduit railway development, and believes we are now beginning an era of such work.

The Electric Storage Battery Company, of Philadelphia, has opened an office in Aldrich Court Building, 45 Broadway, New York city, where cells of the "Chloride" accumulator type may be seen by those interested.

Mr. Chas. J. Bogue, formerly superintendent and electrician for the Standard American Electrical Co. has entered the field of manufacturing supplies, etc., for electric light and power purposes, making a specialty of armature and commutator work. Mr. Bogue has been connected with the Thomson-Houston, Excelsior and American companies, his experience dating back some 12 years. He is therefore well qualified to give general satisfaction in the execution of orders for supplies, apparatus, etc. He has opened offices and factory at 206 Centre street, this city.

Mr. S. W. Rushmore, 89 Liberty street, with shops in Jersey City, has provided himself with unusually good facilities for the heavier class of dynamo and arc lamp repair work, as well as for the building of armatures for arc dynamos and street car motors. He is also fully equipped for turning up heavy commutators and making metallurgical process generators ranging up to 250 h. p. Mr. Rushmore is a designer of ability, and is now winding large armatures for incandescent lighting on a new spiral plan, in which the coils are all alike, and the ventilation is so perfect that the capacity of the machine is increased by a very large percentage. Mr. Rushmore is also making arc lamps for regular street service. Some idea of his facilities may be formed from the fact that he has in his shop a power crane that will lift 20 tons.

WESTERN NOTES.

Roodhouse, Ill.—The Greene County Electric Company has been incorporated by E. M. Prindle, H. Kelsey and J. A. Blanreck.

Mr. Jas. B. Olson of the Chicago office of the New York Insulated Wire Company has returned from a business trip through the northwest.

The Crescent Electric Co., Chicago, has been incorporated with a capital stock of $10,000 by Walter H. Adams, Charles Cohenour and Bernard Elshoff.

Mr. Lucius T. Gibbs, of the Gibbs Electric Co., Milwaukee, and Mr. O. M. Rau, electrician of the Milwaukee Street Ry. Co., were Chicago visitors last week.

The "H. K. W. M." Electric Company, Chicago, has been incorporated with a capital stock of $10,000 by W. Clyde Jones, Geo. L. Cragg, and Geo. S. Buell.

Belleville, Ill.—The electric street railway was put in operation on the 1st inst. The citizens were highly pleased with the road and appropriately celebrated its opening.

The Fontaine Crossing & Electrical Company, Detroit, Mich., have opened a Western office at 1456 Monadnock Block, Chicago, in charge of Mr. Jas. A. Campbell, as general Western agent.

Mr. Wm. Hornberger, of Elkhart transformer fame, was in Chicago several days last week. Mr. Hornberger reports some very satisfactory results of tests made on their larger sizes of transformers recently.

The Great Western Manufacturing Company, Chicago, have moved from their former location on South Canal street, to No. 120 Market street, near Madison, where they will have more rooms, and be nearer the business centre.

Mr. Montgomery H. Johnson, who until recently was associated with the Gibbs Electric Company, Milwaukee, as treasurer and electrical engineer, has severed his connections with that firm and will open a consulting office in Utica, N. Y.

The Columbia Incandescent Lamp Co. have found it necessary to open a Chicago office at 932 Monadnock Block, in charge of Mr. J. M. Hill as manager, a gentleman of long experience in the electrical field, and well qualified to present the good qualities of the Columbia Lamps in an intelligent manner.

The Central Electric Co., Chicago, is experiencing a noticeable increase in its sales of fan motors now that warm weather is here. The direct connected Lundell ceiling fan motor especially, recently illustrated in our columns, is in demand and the company report it as being favorably received by the trade. The sale of Helios arc lamps, for which the Central Electric Co. is Western agent, President McKinlock reports as steadily increasing.

The Mather Electric Company report the sale of two 120 K. W. 500 volt railway generators to the Fox Electric Railway Company of Green Bay, Wisconsin. This sale was made through Mr. J. Holt Gates of 1140 Monadnock Building, Chicago, Ill., western contractor for The Mather Company.

The Western Telephone Construction Company, Chicago, have found it necessary to increase their capital stock from $100,000 to $300,000, increasing also the board of directors from four to seven. This company report an increasing demand for their magneto telephone apparatus, recently illustrated in The Electrical Engineer.

The Electric Appliance Company have decided now that they can again supply the Packard lamp, and to better enable them to push its sale to the greatest possible extent are making arrangements to carry a more extensive stock than has ever been carried before in Chicago. The stock will be well assorted and complete, running in sizes from 5 to 500 candle power and in quantities sufficiently large to fill almost any kind of an order immediately on receipt.

The Trolley in Chicago.—The Chicago City Council at a recent meeting, passed a new measure in which were incorporated as amendments several suggestions made by the Mayor, and in its new form the ordinance is said to be satisfactory to the Mayor and the North and West Chicago street railway companies. Instead of the provision compelling the street railway companies to light the streets, upon which they will have trolley lines, within a radius of a mile from the city hall, a new amendment was adopted, providing for the payment by the companies of $10,000, after the first year, $15,000 after the second, $20,000 after the third and $25,000 at the end of the fourth and each succeeding year, this money to be used by the city in extending its lighting service. A metallic return conductor, independent of the rails, is demanded and suitable guard wires as well as ornamental iron poles, instead of wooden ones, are provided for.

PHILADELPHIA NOTES.

Walker & Kepler recently installed an electric light plant for Mr. John B. Stetson, Ashburne, Pa. The plant consists of two Siemens-Halske shunt wound dynamos, direct connected to one New York Safety 14 x 12 engine. The storage battery plant was furnished by the Consolidated Electric Storage Co.

Mr. C. J. Miller, a graduate of Lehigh University in Electrical Engineering, and for several years superintendent of the Novelty Electric Works of Philadelphia, has established electrical works at No. 4 North Fifth street, Philadelphia. Mr. Miller's mechanical and electrical abilities have been proven in a number of very useful electrical inventions which he has made.

Mr. Geo. W. Warner has resigned his position with Harry S. Smith & Co. Ltd., electrical contractors, and will travel in the interest of The Robinson Machine Co., Drexel Bldg., builders of electric car trucks. The company has its works at Altoona, Pa., and has equipped cars for the Phila. Traction Co., Norristown Street Ry. Co., and other railways in Washington, Altoona, Lebanon, Atlanta, Ga., Chicago and other points.

NEW ENGLAND NOTES.

Webster & Beach have opened a handsome suite of offices at 620 Atlantic avenue, Boston, where they will do a business in general electrical appliances. The firm is composed of Mr. F. W. Webster, late purchasing agent for the General Electric Co., and Mr. R. H. Beach, late manager of the railway supply department of the General Electric Co. in New York. The new firm will carry a full line of electric railway appliances, and will later extend into lighting specialties, and will act as manufacturers' agents. Mr. Webster has been for nine years connected with the Thomson-Houston Co. and the General Electric Co., and is probably as well known to the electrical trade as any man in the country. Mr. Beach, previous to his last engagement, was purchasing agent for the St. Paul office of the General Electric Co. and is also well and favorably known to the trade. Both gentlemen are hard workers, have had large business experience in the electrical trade, and will undoubtedly make a success of their new venture.

The Rose Polytechnic Institute, an advertisement of which appears in this issue, is one of our leading engineering schools and is especially fortunate in its thoroughly modern equipment and plan of instruction. It lays a special emphasis on the practical side of technical education which it is enabled to do throughout the whole course of four years by its ample shops and laboratories and exceptionally complete outfit, especially in electricity.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

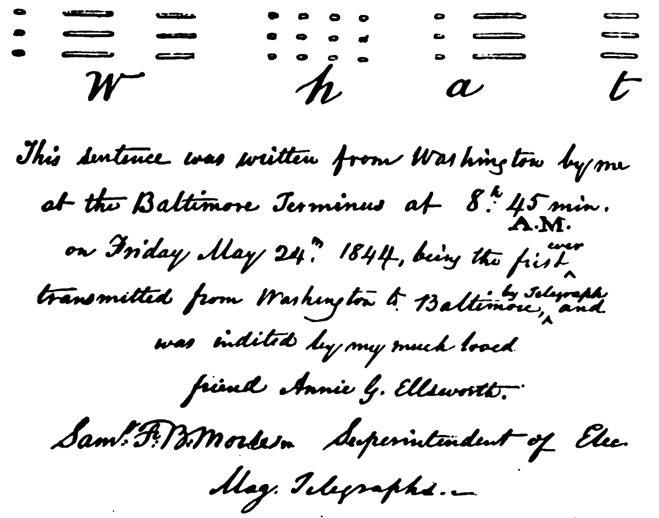
THE
Electrical Engineer.

Vol. XVII. MAY 23, 1894. No. 316.

THE JUBILEE OF THE AMERICAN TELEGRAPH.

Prof. S. F. B. Morse.

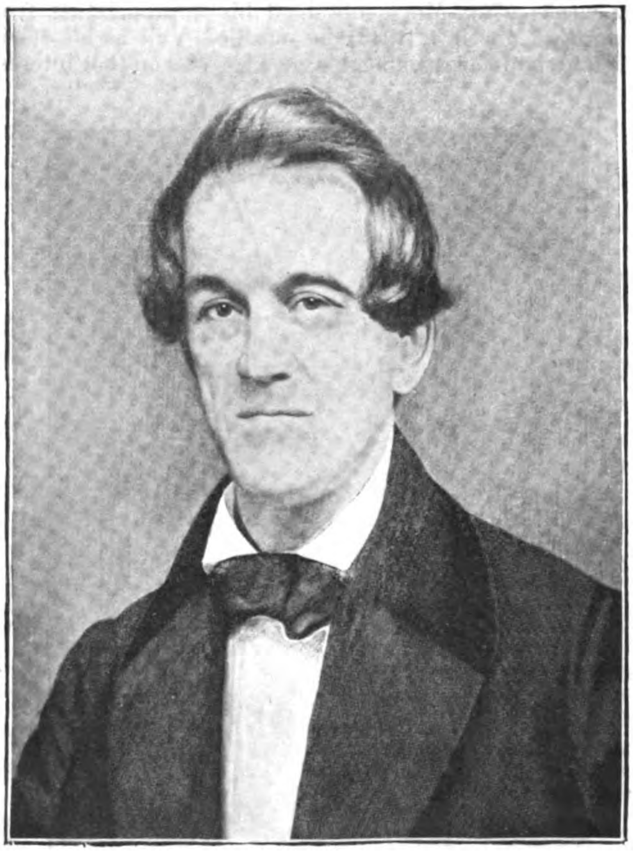
The fact that this year, and this week, witness the jubilee of the telegraph in America, has served to fill the newspapers with reminiscences and to revive the story of the first messages, in a hundred different forms. It has been stated, not for the first time, that the "first message," was one sent on May 1, in a casual way, announcing the national nominations of Clay and Frelinghuysen, but the writer has in his possession a memorandum in Morse's own handwriting of a similar message as to the nomination of Governor Pratt, sent April 30. Be this as it may, the accompanying fac-simile shows that Morse himself regarded May 24, 1844, as the day, and that it was then that the historic message, "What hath God wrought?" was sent by Miss Annie G. Ellsworth, who had been the bearer to Morse of the news in 1843 in Washington, that Congress had appropriated $30,000 for tests of the telegraph. Miss Ellsworth, the daughter of the Commissioner of Patents, a personal friend of Morse, is now the widow of Roswell Smith, late president of the *Century Magazine*. The promise that Morse made to her as a reward for her good news, was carried out on May 24, 1844. The experimental line between Washington and Baltimore had been finished; Morse had set up his instrument in the Supreme Court at Washington, while Alfred Vail had the other one at the Mount Clare depot in Baltimore. Miss Ellsworth now gave Morse the message, suggested by her mother, and that wonderfully apt sentence was transmitted in triplicate to Baltimore. It was the first message ever sent by a recording telegraph. A part of the message, with Prof. Morse's endorsement is here shown, in fac-simile, from the original as preserved by Mrs. Roswell Smith; and a duplicate is in the possession of the State Historical Society at Hartford, Conn.



This sentence was written from Washington by me
at the Baltimore Terminus at 8^{h} 45 min.
A.M.
on Friday May 24^{th} 1844, being the first ever
transmitted from Washington to Baltimore by Telegraph, and
was indited by my much loved
friend Annie G. Ellsworth.
Saml. F. B. Morse Superintendent of Elec.
Mag. Telegraphs.—

FAC-SIMILE OF FIRST MESSAGE, NOW IN POSSESSION OF MRS. ROSWELL SMITH.

Such an occasion as the present is appropriate for rendering credit to those who were the pioneers with Morse in this first great field of electrical engineering. THE ELECTRICAL ENGINEER has just concluded a series of articles by Miss Mary Henry, daughter of Prof. Henry, relating her father's work in this direction, and her filial tribute has left nothing for anyone else to add, so fully, so gracefully and so earnestly has her story been told. Morse's great place in history is well established, and no repetition of the history of his struggles and successes can make his fame greater. We venture, however, to place with these worthies of the past, Alfred Vail, whose work has but too often been overlooked, so that the reaction of the sense of justice has even threatened to do him injury by an unduly enthusiastic attribution to him of pretty well everything that was done in the early days. The probability is that if Morse had not found Vail, he would have hit upon somebody else, but it was providential that these two great men, so admirably supplementing each other, should have come together, the imagination and intuition of the leader, calling out the practical skill and genius of his assistant at



ALFRED VAIL.
(From a portrait in the possession of the Vail Family.)

THE SPEEDWELL IRON WORKS.
(From an old letter head, dated 1847.)

every step of the work. As our readers are well aware, much of the experimental work with the crude telegraph was done at Speedwell, N. J., the home of Vail's father, who supplied funds for the enterprise, and whose iron works are here shown from an old letterhead of 1847. A few weeks after Morse obtained his appropriation from Congress (March 4, 1843) he enrolled Vail as his official assistant, and the document signed by Vail on that interesting occasion is here reproduced. It should be mentioned, however, that a contract already existed between them, dated Sept. 23, 1837, as to the financial devision of the rights in the invention, giving Vail, among other things, one-quarter in this country, which was afterwards changed to three sixteenths. This document is also in the possession of the writer, but is too voluminious and verbose for reproduction here, filling as it does several sheets of manuscript.

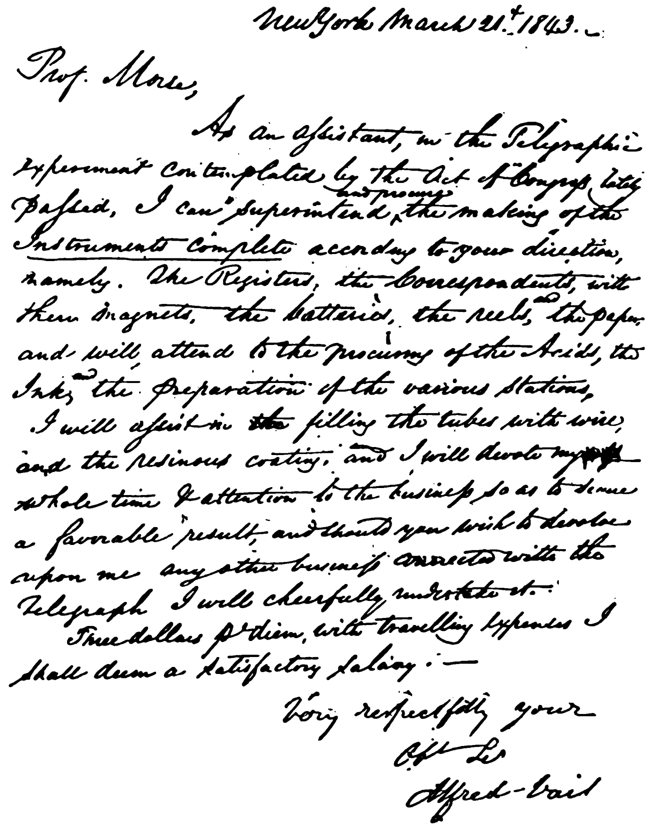
ANNIE G. ELLSWORTH, NOW MRS. ROSWELL SMITH.
(From an ivory miniature painted about 1844, by Freeman.)

Vail began his new duties very promptly, as numerous letters between himself and Prof. Morse testify. We give here the text of Prof. Morse's instructions to him for the little sensational feat of sending the political news on May 1, 1844:

Washington, Apr. 30th, 1844.

Mr. Vail, at Annapolis Junction.

Get everything ready in the morning, for the day, and do not be out of hearing of your bell. When you learn the name of the Vice Prest. nominated, see if you cannot give it to me, and receive from me an acknowledgment of its receipt before the cars leave you. If you can it will do more to excite the wonder of those in the cars, than the mere announcement that the news is gone on to Washington. When the cars are in sight from Baltimore, which will be about 10 a. m. and 5 p. m., prepare me for the announcement; by the letter after the usual beginning and ending. When they arrive at your station, get the name of Vice Prest. If Mr. Evans, write simply - ---— -— —- ---; or Mr. Davis, write —-- -— ---— -- ---, and I will acknowledge by -- --, which means "very well" as well as "yes." Afterwards you can repeat the name and any other information you



New York March 21st 1843.

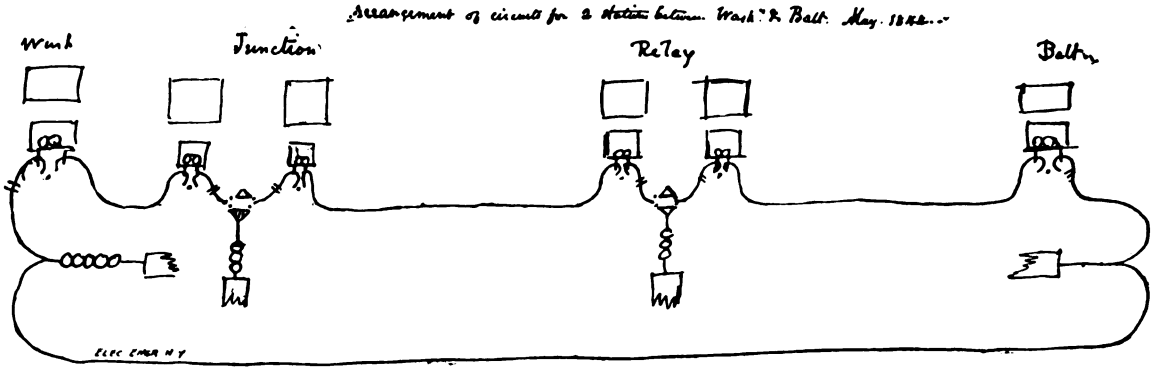
Prof. Morse,

As an assistant, in the Telegraphic
Experiment contemplated by the Act of Congress lately
Passed, I can superintend, and procure the making of the
Instruments complete according to your direction,
namely. The Registers, the Correspondents, with
their Magnets, the batteries, the reels, and the paper,
and will attend to the procuring of the Acids, the
Ink, and the Preparation of the various Stations,
I will assist in ~~the~~ filling the tubes with wire,
and the resinous coating, and I will devote my
whole time & attention to the business so as to secure
a favorable result, and should you wish to devolve
upon me any other business connected with the
Telegraph I will cheerfully undertake it.
Three dollars pr diem, with travelling expenses I
shall deem a satisfactory salary. —

Very respectfully your
Obt Ser
Alfred Vail

VAIL'S CONTRACT AS ASSISTANT SUPERINTENDENT TO MORSE.
(Reduced from the original in the possession of T. C. Martin.)

HENRY L. ELLSWORTH, FIRST U. S. COMMISSIONER OF PATENTS.
(From an old daguerreotype.)

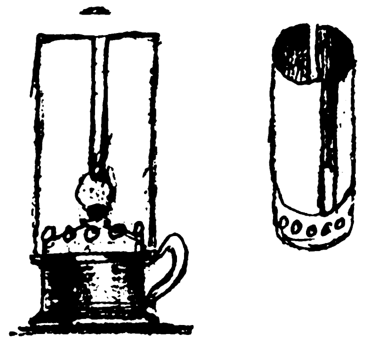

Arrangement of circuits for 2 Station between Wash.n & Balt. May. 1844.
Wash
Junction
Relay
Balt.
Elec Eng N Y

PROF. MORSE'S DIAGRAM OF THE WASHINGTON-BALTIMORE LINE.
(*From original in possession of T. C. Martin.*)

> may have received, but the name of Vice Prest. is of most importance. There will be hours when it is of more importance to be attentive at the Register than at other times. At 10 a. m. until 12 m., from 1 to 3 and from 5 p. m. until 6 or 6½. It may be well to have an evening trial on some dark and perhaps foggy night, to show the independence of the Telegraph on the weather. At 12 m. disconnect so that Mr. Cornell may test the wires to the point where he is at work, and continue disconnected 1 hour. Tell Mr. Cornell this. Do not forget to keep your circuit closed after writing.

On June 14, 1844, Vail, in Baltimore, writes to Morse in Washington: "How beautiful everything worked yesterday! You have furnished a long list of the proceedings of Congress. Will you cut one of the accounts out and put it up in the Rotunda? It may have a good effect. I was visited by hundreds yesterday, and the curiosity is unabated."

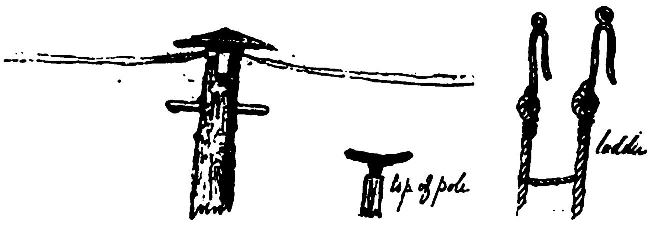
It is a familiar fact that the wires between Washington and Baltimore were first to have been laid underground, and that Ezra Cornell did some very interesting but unsuccessful work in this direction for Morse, even inventing a plow to cut the trench for the reception of the cable. But when the cable was laid from Baltimore to the Relay House, seven miles distant, the leakage was so great that, to Morse's distress, it was found necessary to abandon the plan. He then, by permission of a letter from the U. S. Treasury, dated Feb. 5, 1844, tested the plan "of suspending the conductors on posts above ground," along the Baltimore railroad. For this purpose two No. 14 copper wires, covered with cotton saturated with gum shellac, were strung, held at the poles between two plates of glass. The pole plan had been described by Morse in a letter to the Treasury as early as 1837, as the cheapest, so that the "irrepressible conflict" between the overhead wires and subways began even at that primeval date. The insulating plan now adopted was devised by Mr. Cornell, although it was not long before the bureau knob pattern of insulator was resorted to as far superior to the glass plates with the wooden cover nailed over them.



PROF. MORSE'S SKETCHES OF LINE REPAIR MATERIAL, JUNE, 1844.
(*From original in possession of T. C. Martin.*)

Prof. Morse's personal vigilance and superintendence are evident at every turn. A sheet in his fine penmanship now lies before the writer, who has reproduced from it the little sketches shown herewith. The sheet is dated June 26, 1844, and deals with the questions of repairs on aerial lines. Prof. Morse says:

> Let Cleveland prepare a rope ladder and make some experiments of repair, by putting oak pins in the tops of a few of the posts, thus: the pins may be 16 inches long and an inch in diameter. The articles wanted for repair ordinarily will be, the rope ladder (1), a light pole (2) 20 feet long with an iron cross at top, a coil of wire (3) of 150 feet in length, a spirit lamp (4), a stick of tin for solder (5), a bottle of chloride of zinc (6), a pair of cutting calipers (7). a bottle of alcohol (8), and matches (9); all but 1 and 2 in a small basket.



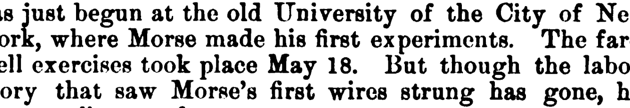
PROF. MORSE'S SKETCHES OF LINE REPAIR MATERIAL, JUNE, 1844.
(*From original in possession of T. C. Martin.*)

Prof. Morse also deals with the problem of temporary repairs in a careful but naïve manner. He says:

> Very little interruption would take place if the train that discovered a break would stop not more than 5 minutes, and being furnished with pieces of wire already prepared for the purpose, anyone could simply unwrap and scrape the broken ends, and unite them by twisting the ends of the pieces of wire to them; and then give notice of the place to the inspector at either terminus, that a more permanent repair may be made. If this is done, so that the wire afterwards does not touch the ground, the communication will be established, and the process of more permanent repair will not break it again.

We do not now expect passengers to jump off a train and make telegraph repairs while the train waits, but these little touches are quaint and show us how long it takes to get the details of a great new art in their proper relation to other things and in their proper perspective of value and importance. Humble and weak as these beginnings were, it is by just such stages and by just such effort all the way, that the great modern telegraph system has been created and perfected.

One pathetic note comes in through all the celebrations of the current week, in the fact that the work of demolition has just begun at the old University of the City of New York, where Morse made his first experiments. The farewell exercises took place May 18. But though the laboratory that saw Morse's first wires strung has gone, his memory lives on forever.



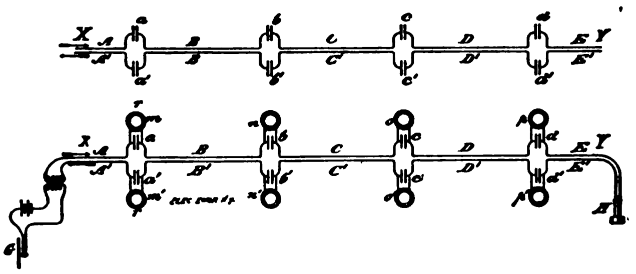
PROF. MORSE'S PLAN OF REPAIRING LINE ALONG RAILROADS.
(*From original sketch in possession of T. C. Martin.*)

PUPIN'S SYSTEM OF RESONATING CONDUCTORS FOR TELEGRAPHY AND TELEPHONY.

Ocean telephony has formed the subject of much discussion and suggestion in the past, but all attempts at a practical solution of the problem have thus far proved unsuccessful. The difficulties standing in the way are well-known, as we have to deal with the combined effects of ohmic resistance, self-induction, distributed electro-static capacity, and absorption due to electrification of the dielectric in long cables. In the paper read by Prof. Sylvanus P. Thompson, before the International Electrical Congress, at Chicago, last year,[1] a variety of methods were described for overcoming some of these disadvantages involving the employment of condensers and inductive coils distributed over the length of the cable, and that paper is a good resumé of what has been suggested up to the present time.

Recently, Dr. M. I. Pupin, of Columbia College, has taken up the question of increasing the speed of signaling on long cables, and extended his investigations also into the realm of telephony both for submarine and land lines. These investigations have resulted in the devising of a method which is described at length in a patent[2] just issued to him.

Dr. Pupin avails himself of several experimental facts demonstrated by him. Every electrical circuit containing self-induction and capacity when subjected to the influence of a periodically varying current has a definite period of vibration, and this period can be changed by varying the coefficient of self-induction or electrostatic capacity, or both; this can be accomplished by "tuning" the circuit. Dr. Pupin has also found that the influence of magnetic and dielectric sluggishness varies with the period of the impressed electromotive forces, more especially with high periods.



Figs. 1 and 2.

The principles above enumerated can be extended in such a way as to include circuits divided into sections by interposed condensers which connect in series the several sections of the circuit, that is to say, that all the rules of tuning a circuit can be applied to such a circuit as to the whole or to any part of it. It enables the time constant and the electromagnetic impedance of a long conductor to be regulated and at the same time also the attenuating effect due to distributed electrostatic capacity and also the electrical absorption in the insulation of such conductor to be diminished.

Dr. Pupin considers the current in the conductor of any section of the cable to consist of two distinct parts. One part is due to the charging of the terminal condensers of that section, and the other is due to the charging of the surface of the conductor itself. The first current he calls the longitudinal displacement component, and the second current the lateral displacement component of the current in that section. The improvement consists, therefore, in diminishing the ratio between the lateral and the longitudinal displacement components of a rapidly varying current. The wasting of a current due to the lateral displacement components in the various parts of a cable acts evidently like an impedance which here includes the impedance due not only to ohmic resistance, self induction, etc., but also the impedance resulting from the lateral displacement currents.

The accompanying illustration Fig. 1 shows diagrammatically the arrangement adopted. The cable is divided into equal sections, A, B, C, D, E, and the return sections, A', B', C', D', E'. A A', B B', etc., act upon each other by electrostatic induction by means of the condensers *a a'*, *b b'*, *c c'*, etc.; or in other words the condensers are connected in series to each other by means of the sections of the cable.

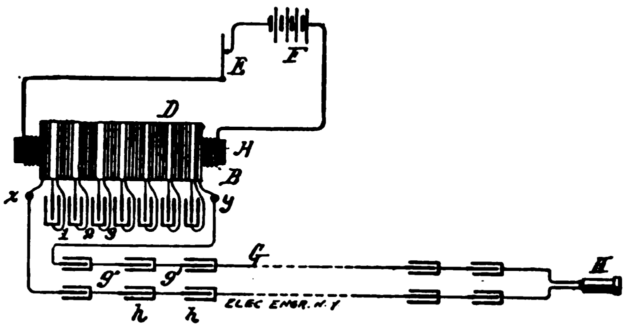


Fig. 3.

In showing the practical application of this method Dr. Pupin assumes the case of a cable six thousand miles long having a total electrostatic capacity of five hundred microfarads. Dividing it into six thousand equal parts, making thus each part one mile long, we would have an electrostatic capacity of one-twelfth microfarad per mile. Interposing six thousand condensers of twenty microfarads each, we have for the total effective electrostatic capacity of the cable $\frac{20 + 1\cdot12}{6000} = \frac{1}{300} + \frac{1}{72000}$ microfarads. That is, we would have reduced the effective eleotrostatic capacity of the cable to nearly one one-hundred and fifty thousandths part of its original value before division, and we would also have the line capacity of the cable very small in comparison to the electrostatic capacity of the interposed condensers. Therefore, the cable may be constructed so that the statical charge of the line at any moment during the variable flow of an electrical current along the cable, can be made small in comparison to the static charge in the interposed condensers; hence the electrostatic absorption of the whole cable can be made practically independent of the dielectric properties of the insulation of the cable, and be confined entirely to the dielectric properties of the insulator employed in the interposed condensers. Hence, if condensers, possessing no electrostatic absorption are used, as, for instance, carefully constructed mica condensers, then the electrostatic absorption of the total cable can be reduced to any practical limit that may be desired.

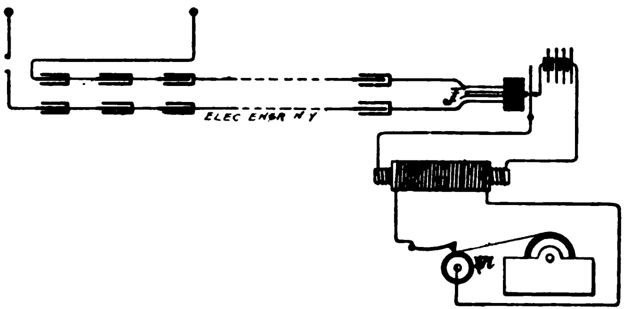


Fig. 4.

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[1] See The Electrical Engineer, Aug. 30, 1893.

[2] No. 519,346, May 8, 1894.

For the purpose of giving the divided cable an uninterrupted metallic circuit so that in case of a break the fault may be located by ordinary methods, there is connected with each condenser in shunt a coil, *m m'*, *n n'*, of many turns, surrounding a closed magnetic circuit, such as an iron ring, *r*, Fig. 2. These coils, in consequence of their large self-induction and also in consequence of their electro-magnetic property will not allow an appreciable part of the main current to pass from one section of the cable to the next as long as the frequency of that main current is anywhere above fifty periods per second. In fact, these coils act, with regard to these frequencies, like electro-magnetic valves. While dwelling more particularly upon the effects of applying his method to telegraphy and telephony, Dr. Pupin proposes to utilize it for the transmission of currents for both lighting and power, and also in the production of light itself.

In connection with his experiments looking to the increase in the speed of telegraphic transmission and especially in securing clear telephonic transmission over long lines having considerable static capacity Dr Pupin has devised a new type of induction coil which is illustrated in Fig. 3. The secondary coil D is divided into a number of equal sections. Between these parts are interposed the equal condensers, 1, 2, 3, 4, so that the coil sections and the condensers are connected in series. The size of the various coils and condensers determines the time constant of the whole secondary coil D.

According to Dr. Pupin, if such a transformer be combined with a line conductor also divided into sections, arranged in inductive relation and in series, or in other words, provided with condensers between the sections, and if both the line and the transformer coil be properly tuned, then the rapidity of transmission may be exceedingly great, the number of messages which may be transmitted over such a line is independent of electrical conditions, simultaneous telephony and telegraphy is practicable, and a telephone current will control a recording telegraphic receiver, as indicated diagrammatically in Fig. 3.

ESTIMATE OF THE DISTANCE TO WHICH NIAGARA WATER POWER CAN BE ECONOMICALLY TRANSMITTED BY ELECTRICITY.

BY

Chas E Emery

THE writer is very grateful to the distinguished electrical engineers, Messrs. Houston and Kennelly, for their very elaborate and interesting paper on this important subject and appreciates the compliment implied by the comparison of the results of their work with those stated in his paper on the "Cost of Steam Power."[1] The results shown are gratifying and surprising, and as a full discussion only serves to emphasize the truth as it appears from various points of view under various conditions, it is proposed to suggest some changes in the data assumed, which it is hoped will be accepted and finally assume a difference in prices which it is thought must be provided for in practice. The result is apparently to reduce materially the radius of economical transmission of water-power electrically, compared with steam generated and utilized on the spot.

In the first place it should be noted that, in very large plants, steam engines can be operated somewhat more economically than the 500 H. P. units of the writer's paper, as was indeed suggested by Prof. Forbes in discussing the paper. Again, Messrs. Houston and Kennelly have charged only 10 per cent. for annual cost of interest, depreciation and repairs, whereas in our paper 5 per cent. is allowed for insurance, taxes and depreciation, 10 per cent. for interest or dividends, so that according to the practice of promoters 5 per cent. interest may be paid on bonds equal in amount to the original cost and 5 per cent. dividends on an equal amount of stock. In addition to this, 2½ per cent. is provided for inspection and 6 per cent. for loss of interest during construction; making in all, if inspection be omitted (as the authors have an item for superintendence), 21 per cent. added to the cost, in our paper for items which the authors of the paper under discussion have only added 10 per cent. For an entirely new work like that in connection with Niagara, the loss of interest during construction will necessarily be very great, but not to take too extreme views, in the modified estimates herewith submitted, only 15 per cent. has been added for interest and the various other charges proportioned to the original cost, instead of the 21 per cent. used by us, or the 10 per cent. used by the authors of the paper.

Again, it is considered that the efficiency of the generators assumed in the paper, viz., 0.94 according to the calculations, (though the types state 0.96), is too high. The simple electrical efficiency of an alternator, considering the copper losses only, can readily be made as high, or higher, than that of a direct current dynamo, but it does not seem possible to make the iron losses as low on account of the comparatively high frequency. We have therefore based our amended calculations on an efficiency of 0.90, which is higher than can probably be realized when the load averages less than full and the copper, iron and strictly mechanical losses are all considered. We have also thought it safer to use 0.96 as the efficiency of the transformers during average work, instead of 0.98 used by the authors of the paper. Our recollection is that comparatively recently the iron losses alone were considered by Mr. Stillwell to be 5 per cent. The combined efficiency of the generator and transformer will then be 0.90 x 0.96 = 0.864, and on the basis that the same joint efficiency will be obtained with the transformers and motors at the end of the line, the combined efficiency of the generator, the motor, and the step-up and the step-down transformers will be $(0.864)^2 = 0.7465$, or, say, 75 per cent.

The very low price of large generators and motors stated will be a gratifying surprise to many, and a careful perusal of the paper shows that this low price is one of the principal elements which makes the transmission through the long distance referred to appear practicable. There is, however, an enormous difference in prices stated in the paper for motors of different sizes, viz., $100 per K. W. for very small motors, $45 per K. W. for 50 K. W. and only $8.516 per K. W. for 1,000 K. W. Accepting, however, without question, the authority of the paper in relation to the cost of the very large generators which can be employed at Niagara, and also the fact that corresponding transformers will be furnished for $4.72 per K. W., the cost of the two will be $13.236 per K. W., as in the paper, but on account of the change of assumed efficiencies the cost, referred to the energy actually delivered by the generators, will be $13.236 ÷ 0.864 = $15.32 per K. W. It is suggested that this price is altogether too low for the conditions which on the average will obtain for the motors where the power is delivered. It will probably not be thought proper to bring the very high voltage used in transmission into a city, and it will not in general be practicable to operate outside the city limits with a few large motors the local machinery in the city without a second transmission and its attendant losses. It is, moreover, a question whether the frequency adopted for the long distance transmission will be suitable for lighting, and extremely doubtful if direct transformation from the long distant circuits should be risked for local lighting circuits. It is probable, therefore, that special motors will be located in each of the several manufacturing establishments in the city, including those for electric lighting and power purposes, and that such special motors will be operated by current from the step down transformers outside the city limits. On this plan the very small motors would be operated from the local circuits as at present. The special motors, operated as part of the transmission system, would on the average be small compared to the size of the generators available at Niagara and therefore the average price be higher. It is therefore submitted that it will be fair to consider the cost of motors raised from $9.581 per K. W. assumed in the paper to at least $15.28 per K. W., to which, adding transformers at $4.72 per K. W., gives as the joint cost of both $20 per K. W. Adding to this only 50 per cent. for spare machinery, a high tension line terminal in the suburbs and sundry details which do not appear to have been considered in the table, we obtain $30 per K. W. as the more probable cost of the motors, transformers, etc., in the vicinity of the city to which the power is to be transmitted, or for the power actually delivered by the motors 30 ÷ 0.864 = $34.72 per K. W. The accuracy of this assumption can only be proved by carefully considering the details of an actual application, but if the figures given be considered simply an assumption they still show the influence that the slightly lower efficiencies and somewhat greater increased costs assumed have on the final result. Amended calculations of the results given in the paper under discussion for Buffalo and Syracuse are herewith presented. The description of the several lines is substantially the same as in the paper and it will be found very convenient for those perusing this discussion to number the lines in the original paper to correspond with the numbers herein.

It thus appears that, on the basis assumed, Buffalo is within and Syracuse outside the circle of economical transmission for a 10 hour day, and that for a 20 hour day both cities are included in such circle. Most of the demand will probably be on a 10 hour basis, the power and lighting periods occurring at different times and overlapping each other. Mills, paper manufactories, etc., requiring power for 24 hours can best be located directly at Niagara Falls and secure the undoubted low rates that will obtain there. It is thought that the first transmission installation which will naturally be for Buffalo will cost even more than estimated above, as time and some tentative work will be required before the application becomes general. The estimate makes no provision for subways, which must be constructed to all points reached. The costs may rise so high that even the transmission to Buffalo will pay only a small percentage on the cost, and conditions better than assumed must be found before there will be much of a market elsewhere.

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[1] Read before the Amer. Inst. Elec. Engrs., March, 1893. Also THE ELECTRICAL ENGINEER, March 29, 1893.

Table showing the cost of transmitting the water power of Niagara electrically to Buffalo and Syracuse, on the basis partly of the quantities given in the original paper of Messrs Houston and Kennelly and partly of the modified quantities referred to above:

No. of Line.		Buffalo.	Syracuse.
0	Distance……………………	15 miles.	164 miles.
1	Maximum delivery…………	22500 K. W.	7500 K. W.
2	For a delivery for a full load motor shaft of. …………	1.000 K. W.	1.000 K. W.
3*	The delivery at line terminals will be ……………	1.157 K. W.	1.157 K. W.
6	Total copper in line per K. W. delivered………	17.82 LBS.	194.8 LBS.
7	Aproximate loss of energy in line ……………………	0.0392 K. W.	0.4286 K. W.
8*	Approximate energy delivered at Niagara line terminals = line 3 + line 7…………	1.196 K. W.	1.586 K. W.
9*	Approximate energy delivered at turbine shafts = line 8 + .864…… …… …………	1.384 K W.	1.835 K W.
9a*	Efficiency of the transmission for full load……………	0.7225	0 5450
9b*	Do. for 60% of full load, about.	0.4335	0.3270
10*	Cost at Niagara of 1.190 K. W. for Buffalo and 1.586 K. W. for Syracuse, at $15.82 per K. W………………………	$18.322 per K. W.	$24.298 per K. W.
11	Cost of copper in line at $0.125 (see lbs. line 6)………	2.228 " " "	24.850 " " "
12*	Cost of 1 K. W. at Buffalo and Syracuse respectively, at $34.72 per K. W. as explained in text…… ……	34 720 " " "	31 720 " " "
13*		$55.270 " " "	$83.368 " " "
14	Cost of line at $1000 per mile (see line 0.)…………	0.67 " " "	21.87 " " "
15*	Total investment…………	$55.94 " " "	$105.24 " " "
16*	Annual cost of investment at 15%……………………	$8.39 per K. W.	$15.79 per K. W.
17*	Cost per K. W. at turbine shaft at $4. (see line 9)……	5.54 " " "	7 34 " " "
18		$13.93 " " "	$23.13 " " "
19	Labor, superintendence and general expenses…………	2.68 " " "	2.68 " " "
20*	Annual cost at sustained full load……………………	$16.61 " " "	$25.81 " " "
21*	Annual cost at 60% full load…	$27 68 per K. W.	$43.02 per K W.
22*	Annual cost at 60% full load…	$20.65 per H. P.	$32.09 per H. P.
23	By Emery's table† the cost of generating steam power with coal at $3 per ton for a year of 308 days of 10 hours……………………	$25.27 per H. P.	$25.27 per H. P.
24	By Emery's table† the cost of generating steam power with coal at $3 per ton for a year of 365 days of 20 hours……………………	$44.43 per H. P.	$44.43 per H. P.

* This mark designates the lines which are modified by the considerations stated in the text.

† This is with large triple expansion compound engines as per lines J and K of table in Trans. Am. Inst. Elec. Engrs, March, 1893.

The estimates show plainly that the allowable first cost of developing a water-power in competition with steam, stated in our paper as $140 per H. P. on a 10 hour basis, is in connection with a transmission plant greatly modified by the efficiency of the transmission stated in lines 9a and 9b.

APPLICATION has been made by the street railway company of Newburgh, N. Y., for permission to change the motive power of its lines from horses to electricity.

ON THE SUBDIVISION AND DISTRIBUTION OF ARTIFICIAL SOURCES OF ILLUMINATION.[1]

BY PROF. WILLIAM A. ANTHONY.

IT is a well-recognized principle that to illuminate evenly a given area by means of an artificial source, it is necessary that this source should consist of numerous small sources distributed over the area. In carrying out this principle it is usual to divide the area to be lighted into squares, and place a lamp in the center of each square as shown in Fig. 1, where each lamp is represented by the sign ×. In order to study the distribution of light by this arrangement of lamps I have computed the illumination at the central point of the figure due to the lamps situated upon the boundaries of each of the squares represented by the dotted lines, the illumination produced by the lamps on the smallest square to be taken as unity. The following table gives the values up to the twelfth square, twice the number represented in Fig. 1, and corresponding, therefore, to an installation in which four times as m ny lamps are used.

I.	II.	III.	IV.	V.
1	1.000	1 000	4	4
2	.511	1.511	12	16
3	.312	1.823	20	36
4	.223	2 046	28	64
5	.174	2.220	36	100
6	.143	2 363	44	144
7	.121	2.484	52	196
8	.104	2.588	60	256
9	.092	2.680	68	324
10	.083	2.763	76	400
11	.075	2 838	84	484
12	.067	2.905	92	576

Column I gives the designating number of each square counting outward from the central point. Column II gives the illumination at the centre due to the lamps located on each boundary. Column III gives the total illumination at the centre due to the lamps included within and upon each boundary. Column IV gives the number of lamps situated upon each boundary. Column V gives the total number of lamps.

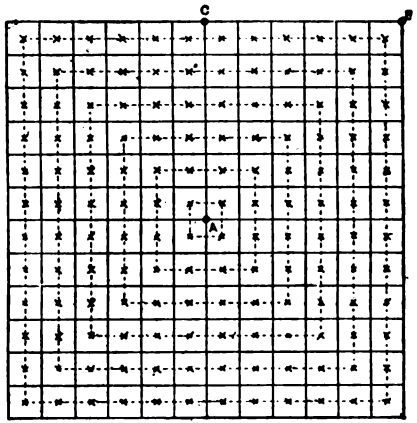

FIG. 1.

It is seen from the table that the twelfth series which consists of 92 lamps gives at the centre less than 7 per cent. as much light as the first series of four lamps, and contributes only about two and one half per cent. to the total illumination at the centre. This arrangement of the lamps does not give an even distribution of light over the entire area, as will be evident from a consideration of the illumination upon the outside boundaries of the space. It is evident that the point B at the corner of Fig. 1 receives one-fourth as much light as it would do if it were the centre of an area four times as large, and lighted by four times as many or 576 lights. But the illumination at the centre of such an area as seen by the table is 2.905. The illumination at B is, therefore, 2.905 ÷ 4 or .726, while the illumination at A from the sixth line of the table is 2.363. The illumination at B is then less than one-third that at A. At C the illumination is evidently but little more than half that at A. Points located between the centre and outside would be illuminated to an intermediate degree, but after leaving the outer boundary the illumination would rapidly approach that at the centre of the figure. I am considering always points of least illumination in any region, that is, points situated as far as possible from any lamp. It is evident, therefore, that to obtain a uniform distribution of light, the lamps must be concentrated toward the outer boundary of the space instead of being placed at equal distances throughout, as in the figure.

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[1] A paper read at the Eleventh General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 15th, 1894.

But the most interesting question connected with this matter is: What is the effect upon the uniformity of the illumination of grouping the lamps in clusters or using larger lamps at fewer points? It is evident that whatever the candle power of the lamps or their distances apart in a distribution like that represented in Fig. 1, the *relations* represented in the table will remain unchanged. It is evident also that the illumination at the central point will be proportional to the intensity of the individual sources (if lamps are placed in clusters each cluster is to be considered as a source) and inversely to the square of the distance between the sources.

The illumination is, therefore, given by the formula

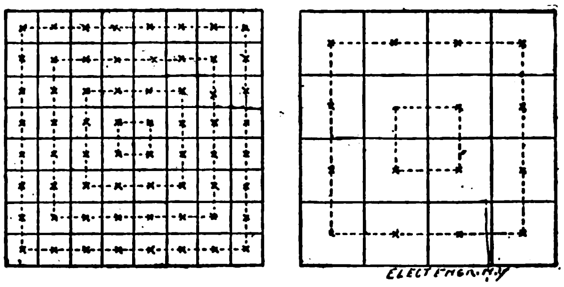
$$K \frac{s}{d^2} C$$

where K is a constant depending on the units employed, s the intensity of the individual sources, d the common distance between them, and C the quantity in column III of the table corresponding to the number of sources as found in column V.

Compare the illumination at the centre of an area lighted by 576 lamps with that at the centre of the same area lighted by the same lamps arranged in 144 clusters of four lamps each. If s and d represent the intensity and distance in the first case, $4s$ and $2d$ will represent the corresponding quantities in the second case. C in the first case is 2.905, corresponding to 576 sources. In the second case, for 144 sources, C is 2.363. The relation sought is, therefore,

$$\frac{K \frac{4\,s}{4\,d^2}\, 2.363}{K \frac{s}{d^2}\, 2.905} = .813.$$

The light at the central point with the fewer sources, is only 81 per cent. of that obtained under the first arrangement. Other points of minimum illumination will suffer in like manner. On the other hand, points near the clusters of lamps will be much more strongly illuminated than corresponding points near the single lamps of the first arrangement.



FIGS. 2 AND 3.

If it be required that the illumination at no point shall be less in the second case than in the first, it will be necessary to increase the intensity of the sources nearly 25 per cent., or make the clusters consist of five instead of four lamps.

Again, suppose an area lighted by 64 sixteen c. p lamps distributed as in Fig. 2. It is required to substitute 16 lamps of larger candle power distributed as in Fig. 3, and fulfilling the condition that the minimum illumination shall be no less in the latter case. If x be the candle power of the larger lamps, we have:

$$\frac{x}{4\,d^2} \times 1.511 = \frac{16}{d^2} \times 2.046$$

$$x = 64 \times \frac{2.046}{1.511} = 86.7.$$

From which it appears that the total candle power must be increased 35½ per cent. If the 16 candle power lamps consumed 3.5 watts per candle, the larger lamps to compete with them should consume less than 2 6 watts per candle.

It will be noted from the two examples given, that the loss from reducing the number of sources in a given ratio is less when the number is large. In other words, large lamps, or clusters of lamps, can be more economically used for large, than for small areas.

An inspection of the table will show, that while a given area may be lighted satisfactorily by 16 clusters of four lamps each, an area one-fourth as large, lighted by four clusters at the same distance apart, would not be as well lighted with six lamps to the cluster. It will be seen also that the larger the area, the further apart may lamps of the same candle power be placed. For example a room 40 feet square with 16 lamps 10 feet apart, is fully as well lighted as a room 16 feet square with four lamps eight feet apart.

Let us compare arc and incandescent lamps on the same basis, that the minimum illumination shall be the same under both systems. First, I must say that the efficiency of arc lights has been greatly overrated. Instead of being ten times, it is rarely three times, and often only one and a half times that of an incandescent lamp.[2] This is for the naked arc. For indoor illumination, ground or opal globes are nearly always used, and these cut off fully half the light.[3] This leaves the efficiency at the most 1.5 times that of the incandescent lamp. The power required for a 16 candle incandescent lamp is 50 watts, and for a full arc lamp 450 watts. The arc lamp must, therefore, replace nine incandescents. Assuming that the lamps are distributed as described in this paper, the table shows that if four arcs take the place of 36 incandescents, their efficiency as compared with the incandescents must be 1.823, and with a relative efficiency of only 1.5, the arc lamps would not light the space as well as the incandescents. If 16 arcs take the place of 144 incandescents, the ratio of the efficiencies required is 1.56, and arcs at 1.5 are still not equal to the incandescents. If 64 arcs take the place of 576 incandescents, the ratio of the efficiencies becomes 1.42, and arcs at 1.5 would be an improvement on the incandescents. It then comes to this, that unless the area to be lighted is so large as to require about 500 incandescent lamps distributed uniformally over it, the use of full arc lamps requiring the same power, will leave some parts of the area less brilliantly lighted.

If we could make small arc lamps of the same efficiency as the full arc—by full arc I mean the so-called 2,000 candle lamp consuming about 450 watts—we could improve somewhat upon the result as obtained above. But the fact that the mechanism of a small arc lamp costs just as much as that of a large one, and that *each* small arc will require as much care and attention as a large one, would place a limit upon the subdivision of the arc even if the efficiency could be maintained. And here I wish to enter a protest against the assumption that I often find in discussions of this subject, that the *so-called* 1,200 and 2,000-candle power arc lamps *are* 1,200 and 2,000 candle lamps. There is no 450 watt arc lamp in use that will measure 2,000-candles in the direction of greatest intensity, and compared with other artificial sources for general illumination, that is measured as other sources are measured, there is no 450 watt lamp that will give, when surrounded by a plain glass globe, 500 candles.

In a linear distribution, as in street lighting, the arc is at a still greater disadvantage. Remembering that nine 16-candle incandescent lamps can be run with the power required for one 450-watt arc, it is seen that the arcs must be nine times as far apart as incandescents consuming the same power, and to give the same minimum illumination must be 81 times as intense, or about 1,300 candle power. But in no arc lamp as used for street lighting, do the rays proceeding toward the most distant points to be illuminated, reach more than one-fourth this intensity. In my way of thinking, the location of arc lamps at intervals of 1,000 to 1,600 feet as they are often seen in pretentious country villages and suburban places is an entire waste of money. A little spot 50 to 100 feet in diameter under each lamp is brilliantly lighted, while the more distant points are in darkness all the more profound from the loss of sensitiveness of the eye when in the strong light. Incandescent lamps at intervals of 100 to 200 feet, which could be run by the same power, would give a far better illumination.

Of course, in deciding between the use of arc and incandescent lamps in any special case, there are other questions to be considered besides that of the power required to operate. Practical questions of installation may outweigh all others. The considerations of these is foreign to this paper. The question I have considered is purely one of efficiency, and in treating that question I have assumed that every part of a space to be lighted, *needs* the same amount of light. I have omitted from the consideration all effects of reflection from ceilings, walls or reflectors purposely provided, as these are too various and depend too much upon the conditions in each special case to be introduced into a general discussion. My main object has been to point out to just what extent the general illumination of a space is affected, other things being equal, by the use of large in the place of small sources using in the aggregate the same power, and I trust the figures and illustrations I have given may be found useful in considering the special cases that may arise.

ELECTRICAL TRANSMISSION IN MILWAUKEE.

IT is suggested to utilize the water power of the upper Milwaukee River for an electrical generating plant to supply lighting to the city of Milwaukee. Mr. Muenzberg, of the Board of Aldermen, is interested in the plan.

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[2] See "Efficiency of Artificial Methods of Illumination." Dr. Nichols: TRANSACTIONS, vol. vi., p. 171.

[3] "Loss of Light from Use of Globes with Arc Lamps." George D. Shepardson: *Electrical World*, vol. xxiii., p. 287.

A REVIEW OF THE PROGRESS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.[1]

BY EDWIN J. HOUSTON, PH.D.

I APPRECIATE the very high honor you have conferred on me in again electing me to the Presidency of the Institute. I beg to assure you that it will be my earnest endeavor faithfully to discharge the duties thus imposed on me.

The American Institute of Electrical Engineers is in no sense a local organization. It has in view the interests of no particular section of country, but on the contrary, is a national body. It represents the electrical profession in all parts of our great land, and welcomes into its membership bright and progressive men in the electrical profession wherever they may be located. But while the Institute is in no sense a local body, so that no city can properly claim as a right the high privilege of having the annual meeting held in it, yet there is, perhaps, at this time a special fitness that the annual meeting which witnesses the closing of the first decade of our association should be held in the City of Brotherly Love, where the Institute had its birth.

The International Electrical Exhibition held in 1884, in Philadelphia under the auspices of the Franklin Institute of the State of Pennsylvania, was called together at an exceedingly favorable moment. Eight years have elapsed since the Centennial Exhibition of 1876 in Philadelphia had sown broadcast the germs of public interest in electricity, and thus laid the foundation for a belief in the brightest promises of the electric future. These germs, carried to all parts of the land, were beginning to bear fruit, and a body of earnest and intelligent workers had sprung up on all sides, so that our comparatively limited knowledge of electrical science was markedly increased, although in an extremely irregular and unsystematic manner.

Between 1876 and 1884, nearly a decade, the work done in the electrical field was necessarily of a pioneer and independent character. The great principles of the science already discovered and announced were but vaguely understood and needed the practical men to carry them into actual commercial use. To a great extent, each investigator trod the path of discovery alone, gropingly penetrating into the regions of the unknown accompanied by his fellow investigator and often, indeed, conscious of his existence. Had this early work been properly organized, much of the labor expended in going over ground already trodden might have been saved, but it is by no means clear that this labor was in vain for the weal of the electric future; for, truths thus repeatedly wrested from nature and established again and again by independent investigators, cannot be too highly prized.

In our Nineteenth Century activity events move rapidly. In less than a decade from the time of the Centennial Exhibition of 1876, namely in 1884, the time had come when the advantages of congregation as opposed to segregation were to be demonstrated, when the lonely investigator was to be brought into contact with his brother toiler and taught the advantages of organized work and a free exchange of ideas.

Happily, the International Electrical Exhibition in Philadelphia of 1884, already alluded to, brought together the workers in electricity both in this country, and to a certain extent, in other parts of the world, not only during the Exhibition itself, but especially during the completion of the buildings and the arrangement of the exhibits. The varied exhibits thus brought together from all sides were a revelation to these hitherto independent workers, and showed them, from what had already been accomplished by electrical science, what might reasonably be expected in the near future. The stimulus, so excited, culminated in the organization of the distinguished body I have now the honor of addressing.

At the same time the U. S. Government appointed a United States Electrical Commission authorizing it to conduct a National Conference of Electricians in Philadelphia during the progress of the International Electrical Exhibition. Fortunately for the cause of electrical science, the commission after due deliberation determined to appoint as members of this Conference not only those investigators in the physical laboratory and lecture room, the college and university professors whose labors have always proved of such immense value to the world's weal, but also those equally important investigators, the inventor and actual worker in the commercial electrical field, whose knowledge of principles is based on actual experience, a class that proves the correctness of its ideas by subjecting them to the test of actual trial on a commercial scale.

There was thus convened in 1884, in the city of Philadelphia, a notable gathering of men who had long toiled in the electric field, both in the so-called pure sciences and in the applied sciences, and I feel sure that each class recognized the fact that it learned much from the other. In this notable assembly of electrical students our American Institute of Electrical Engineers originated. I may be pardoned if I briefly review the facts attending its inauguration.

The first step was the circulation in April, 1884, by Mr. N. S. Keith, of a paper asking for signatures for the purpose of organizing a proposed National Electrical Society, for affiliation with sister societies; for the possession of a library, the institution of original research; protection from unfavorable legislation; the settlement of disputed electrical questions, and the exchange of volumes of transactions with foreign and other electrical scientific societies. A preliminary meeting was called on April 15th, 1884, in the city of New York, at which a series of resolutions were passed, and a committee of organization appointed to call a meeting, which was subsequently held on May 13th, 1884, when rules of order were adopted and officers were elected. The first regular meeting of the Institute was held in Philadelphia, October 7th and 8th, 1884, in one of the Exhibition Buildings in West Philadelphia.

From this small beginning our Institute has assumed its present proportions. Its growth was, at first, uncertain, but its vitality was undoubted, and its present rate of increase is fully equal to that of our English cousin; viz., the Institution of Electrical Engineers. I append a curve showing the membership of both bodies at different dates, and although the London Institution had the start and has the advantage of us in membership, yet I look forward in the near future to a membership in our body that will be fully on a par with theirs.

I think it would be difficult properly to estimate the good that has accrued to electric science, not only in this country but also in the world at large, from a properly organized association of specialists in a practical branch of science like that of electricity. If we can properly trace, from the circumstances attending a single electrical exhibition and series of conferences held in Philadelphia in 1884, a great awakening in the field of electricity, what must have been the influence for good, exerted by a body like ours, which I think I am correct in saying includes all the distinguished electricians in this country.

In order to inquire what has been the nature of this influence let us briefly examine the history of the American Institute of Electrical Engineers during the ten years that have elapsed since its foundation and see whether, in the first decade of its existence it has duly availed itself of its great opportunities. Let us inquire what great inventions and investigations have been made by its members. I think that as a result of its inquiries, you will agree with me that our Institution has nobly fulfilled the expectations reposed in it, and that electricity is much further advanced than it would have been had the American Institute of Electrical Engineers never been organized.

A glance at the Transactions of the Institute will show the extended and valuable character of the work of its members. This work embraces notable inventions, extended commercial applications, and valuable researches, as, for example, researches in high frequency discharges; the development of alternating current apparatus for electric welding, and for the transmission of power; improvements in continuous current apparatus; improvements in the practical applications and control of electric motors for traction, mining, manufacturing and other purposes; improvements in telephony and telegraphy; improvements in the application of electricity to various chemical processes; improvements in designs for electric machinery; improvements in electric lighting apparatus of various descriptions, and developments in electro-therapy.

The work of the Institute as a body has also been of a broad and valuable character. I have already pointed out to you, in my inaugural address of last year, the valuable contribution the Institute made to the Chicago Congress and Exhibition of 1893. Since that time, as you are aware, organized work, under the auspices of the Institute, has been and is being, carried out in different parts of the country, as well as in England, for the completion of some of the work the Chicago Congress was obliged to leave incompleted, viz., the determination of suitable standards of light and of illumination.

Another action of which I think the Institute may be proud, has been its provisional adoption of the well-known names of gilbert, oersted, gauss and weber, for the most important quantities in the magnetic circuit, thus filling a well defined void in the practical development of the dynamo, motor and magnets generally. These names have already been favorably commented on in Europe, where they have been embodied in at least one standard text-book.

Up to this date there has been much uncertainty as to the meaning which should properly be attached to the very important term "inductance." It was hoped that the Chicago Congress would decide this question, but as this hope was not realized, the Institute, by appealing to the prominent affiliated institutions in Europe, has been enabled to entertain the consensus of opinion upon this matter among electrical engineers all over the world, and has to-day adopted the meaning of "inductance" as a "coefficient of induction," this being the world's majority verdict, so far as it has been possible to obtain it without the aid of an International Congress. It has also adopted the word "reactance" for that quantity in alternating current circuits, whose square added to the square of the resistance is the square of the impedance.

It would be ungenerous in me in thus reviewing the causes which have led to the development of electrical science in this country, to fail to mention another potent factor. I refer to the electrical press. I recognize its power and the good it has accomplished in spreading broadcast over the country, not only to the members of the Institute, but to all interested in electrical progress, the knowledge of every great advance made in electric science. In a certain sense, however, the electrical press supplements the influence of the Institute, because the press, unlike the Institute, cannot bring electrical workers together, but can only guide and disseminate the conclusions they have reached.

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[1] Inaugural presidential address, delivered at the Annual Meeting of the American Institute of Electrical Engineers, May 15, 1894.

The growth of the electrical press has kept pace with the growth of electrical science. In 1876 the power of the press was considerably feeble. The exhibition of 1884 caused, perhaps, as great an increase in the power and influence of the press, as it did in the development of the science of electricity itself, and, great as has been the marked improvement in electrical science, as demonstrated by the Chicago Congress of 1893, I think close observers will agree with me that such progress has been fully equaled by the wonderful improvement in the electrical press of our country.

There is another Association of Electrical Engineers of the same high standing and governed practically by the same principles as that of the American Institute of Electrical Engineers, and this is our affiliated association, the Institution of Electrical Engineers, with its headquarters in London, England. Like our association its membership contains the leading electrical engineers and experts both in the country in which it is located, and in the surrounding countries.

France has established a somewhat similar body in her Société Internationale des Electriciens, located in Paris. This Society has the same general characteristics as the American and English societies, and, like them, publishes regular transactions of its proceedings. Germany has the Elektrotechnische Verein, a National Physical Laboratory, a well conducted technical press, and electrical exhibitions, such as that of Frankfort in 1891.

Although there are electrical societies in other parts of the world, yet in none of these countries is to be found that organized effort and concentration in one central body of the electricians from all parts of the country, as is so markedly seen in the United States, England, France and Germany.

It is, I think, a significant fact, that the countries in which there has been so marked a progress in electrical invention and engineering, are those which possess the advantages of this combined effort on the part of all its electricians. The reason is, I think, evident; under these circumstances, there exists the enthusiasm which comes from properly organized effort; the rapid progress which is encouraged by friendly rivalry and the incentive to increased and continued effort bred of healthy competition. I think I can safely assert that America, England, France and Germany owe much of their marked advance in electrical science to the existence of their organized bodies of electricians, such as is found in the American Institute of Electrical Engineers, the Institution of Electrical Engineers, the Société Internationale des Electriciens, the Elektrotechnische Verein and the Physikalisch-Technische Reichsanstalt and I feel sure from the great number of able electricians of Italy, Austria, Switzerland, Belgium, Russia, India and other parts of the world, that the progress made in these countries, a progress which is confessedly great, would be still greater if they but tried the advantages of electrical work conducted on the co-operative plan.

It may be advantageous here to review some of the advantages of membership in such learned associations, as for example, the Institute in which we are the most interested. Among the many advantages are the following: Concentration of effort; increased mentality excited by generous rivalry; systematic explorations into the domains of the unknown; a tacit agreement as to what shall be regarded as the standard of good work; the practical establishment of a practical high court of last resort by whom all disputed technical questions in electrical engineering shall finally be settled; the removal of electric work from the region of guesswork to that of certainty, permitting results to be as surely predicted as in other sciences, and consequently the increased stimulus to the successsul investment of capital in electrical enterprises; the reduction of misdirected effort by the promulgation of information concerning what has been attempted or achieved in any direction; and, last but not least, the means of establishing a rapid intercommunication of ideas, between different parts of the country to others.

As to the privileges of membership in our association, a member of any part of the country, whether in Maine, Florida, Illinois, or elsewhere can, after submitting a paper to a Committee appointed by the Institute for that purpose, have it read simultaneously at the New York, and Chicago meetings, and thus not only derive the advantages which come from the broad dissemination of his ideas over the country, but can also have these derived from criticism by those best adapted to judge and discuss them. Instead of being obliged to wait and wonder if his results were valuable or correct, or instead of being forced to endeavor to solve such questions for himself, he is now, by means of the powerful machinery of our association, enabled to hear in a very short time the opinion of those best suited to sit in judgment on his work.

We are naturally and properly proud of the progress shown by our Institute in the first decade of its existence. I ask you now in all seriousness, how has this progress been assured? Clearly by the establishment of a central organized body, as distinguished from separate, independent, and possibly antagonistic bodies; by the establishment of a central body which derives authority from a membership extending over the entire country. Is it credible that independent, disconnected, and possibly antagonistic societies, located in as many separate cities as there are groups of members sufficient to form separate cocieties, can hope to accomplish as much good in so short a time as has been accomplished? Would not the disintegration of our Institute prove to the electrical engineers of this country little short of a calamity. Might not the establishment of separate organizations result in mutual jealousies and intense sectional feeling and, consequently, in a tendency to the continuance of errors once contracted? Partisanship and intelligent scientific work, in the nature of things, have nothing in common. The true scientific instinct is shown in the desire to know the truth for the truth's sake, and the true electrical engineering instinct is to accomplish the best work in the most economical manner possible. To ensure the greatest success I feel sure you will agree with me there must of necessity be a central governing body, viz., the Council of the Institute deriving its authority from a membership extending all over the country, and vested with the power of speaking authoritatively for the Institute between the periods of its recognized official meetings.

In a country like ours, in which distances are so great, a difficulty exists in all our members attending the meetings of a central body no matter where such meetings might be called. This difficulty is real and like all geographical difficulties cannot readily be solved. I think our association has, however, to a great extent, solved it by encouraging simultaneous meetings in all parts of the country where the same paper can be read and discussions had thereon, yet at the same time, holding the governing body the Board of Managers or the Council of the Institute responsible for the proper direction of its work. That all local meetings must be amenable to the organic law of the Institute, be that law what you may choose to make it, I think needs no discussion. I am glad to say that there has already under due authority, of the Institute, local meetings have been established in the city of Chicago, and I trust there may soon be other meetings held in all other great centres of population where our membership will warrant it.

Such I think are some of the advantages of organization under a central body as opposed to organization under separate, independent bodies. They are briefly the advantages of concentration as opposed to those of diffusion, of directed organized effort as opposed to unorganized, undirected effort. To argue in favor of the latter would be, I think, to deny the advantages of a central government, like our national government at Washington. with its equal representation from all the various states of the Union, and to revert to the condition of State Sovereignity, an un-American and altogether untenable position.

As I look over this assembly of distinguished electricians I am particularly impressed with this thought: Our average member though old in actual experience, is nevertheless seldom hoary in years. There must be something in electricity, though what it is I would not venture to say, which attracts the younger and more vigorous members of our race to its study. Perchance it may be that in this mysterious force, there exists some lingering traces of the long-sought-for "fountain of youth," but, be it what it may, I find in the fact that such comparatively young men have been able to do so much for the world's weal in a special science, a bright promise of what they may be able to accomplish before their tasks are completed.

Such is the record of the past ten years of our Institute! What will be the history of its next ten years? I look forward confidently to a still greater and more marked progress than that which has characterized it during the first decade of its existence. I believe that during the next decade its standing will be such that all notable achievements and discoveries in the electrical field in this country will either originate in this body, or be carried out under its direction, and that the American Institute of Electrical Engineers will be the acknowledged centre of the industry and art it now so ably represents.

But while I believe I see so bright a future for our American Institute of Electrical Engineers, I must not be unmindful of the fact I have so earnestly endeavored to point out, viz., the advantages to be derived from co-operation and that our Institute is only one of several such organizations in different parts of the world, and that the highest purposes of the science and art in which our interests are so closely centered, can only best be realized by the most cordial sympathy and hearty co-operation with all associated societies and their members, wherever they may be.

Mr. R. C. Brown has resigned his position as superintendent of electric power of the West End Street Railway Company, of Boston, which he has held with great credit to himself for the past five years, and has assumed a similar position with the Montreal Street Railway Company.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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Western Editor and Manager, C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum, $3.00
Four or more Copies, in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - - - - - - - - - - .10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* THE ELECTRICAL ENGINEER. *Communications for the attention of the editors should be addressed,* EDITOR OF THE ELECTRICAL ENGINEER, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

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THE TELEGRAPH, 1844-1894.

TO-MORROW (May 24), witnesses the jubilee anniversary of the sending the first telegraph message in America. Such an occasion is naturally one of great interest, and we are glad to see that in various ways note is made of it. The conditions and surroundings of the modern telegraph our readers are familiar with, but it is only right and proper that we should enable them to contrast the present with the past by showing what the past was. A glimpse of the conditions that prevailed in 1844 is given in the brief, illustrated article on the subject in this issue.

The telegraph has had a mighty growth since the days when Morse proposed that if a wire broke, the passengers or conductors on the train next coming along should stop the train, get out, and make repairs. There are to-day about 1,000,000 miles of telegraph line in the world, representing about 2,500,000 miles of circuit. There are also about 100,000 miles of submarine cable. About 300,000,000 messages are sent every year, by the world's telegraphs, and about 475,000 offices handle the traffic, from which a revenue of about $450,000,000 is derived. A cable fleet of some forty ships lays and maintains the submarine links in this service. Just how many people the art of telegraphy and allied arts give employment to, it is difficult to determine, but it certainly runs up into the hundreds of thousands.

Much is left for the telegraph to do. Large regions are still without it, and the Pacific some day must have as many cables as the Atlantic. Discussion as to the value of the telegraph as a factor in civilization will develop many differences of opinion, and some persons may even be found to deny that it adds to the sum of human comfort and convenience. The one grand, convincing argument as to the inestimable value of this means of intercourse and of exchanging intelligence is given in the few statistics we have quoted as to the status of the industry in 1894:

RESONATING CONDUCTORS.

IT is one of the curious, though not uncommon, facts in physical research that the pernicious effects encountered by experimenters are later turned to useful account and lead to most brilliant results. When Hopkinson in 1884 noticed the extreme rise in potential in an alternating current to which a capacity had been added, and when Ferranti in 1888 observed the rise in potential at the further end of his Deptford mains, none would have supposed that this same effect would so soon be applied to new purposes and to overcome difficulties heretofore deemed insuperable. Mr. Tesla was among those who early recognized their vast importance, which led him to some of those brilliant series of experiments involving high potentials and high frequencies. Working in the same line Prof. Pupin has devoted himself specially to the study of these "resonance" effects at low frequencies such as those directly obtainable from alternators or other electric current generating devices. His beautiful experimental lecture delivered before the American Institute of Electrical Engineers in May of last year gave sufficient evidence of the wide field here open for research and we are glad to note that within a comparatively short time results have been reached which promise to be of the utmost practical importance. Recognizing the difficulty of getting alternating current over a circuit containing distributed electrostatic capacity it occurred to Dr. Pupin to divide such a circuit up into small sections and to time each such section by the insertion of condensers in series, in the manner described elsewhere in this issue. The reduction in effective electrostatic capacity of the circuit by this method makes it possible to obtain results not heretofore possible.

An ocean cable presents probably the worst case for treatment by the method of Dr. Pupin, and the supposititious example selected for illustrating the method, as given on another page, is only intended to show how such a circuit would be influenced by the application of the method indicated. It is probably too much to hope that the method could be practically applied to ocean cables laid at the present time, for reasons which are not far to seek, but we see no difficulties whatever standing in the way of its application to existing land lines for telegraphy and especially telephony. Of the amount of current sent into the line at the New York end of the New York-Chicago Long Distance telephone line, but an exceedingly small fraction reaches Chicago; so that even a slight increase would have a marked effect on the character of the received transmission. But we need scarcely go so far to indicate the great benefits which would result by the successful application of such a method to telephone lines of shorter length, while on the other hand it opens up prospects in long distance telephony which one scarcely dares to contemplate. What has just been said bears equally well on telegraph lines. The application of Dr. Pupin's system will naturally involve the expense of numerous condensers. But if it be a question as between increased copper and condensers in order to obtain given results, we believe that the latter will be found to be by far the more economical of the two. Looking farther still at the possible applications of Dr. Pupin's method, it also bears promise of successful application to the transmission of heavy currents and all that this implies. We understand also that Dr. Pupin has carried his experiments involving the same principles into the realms of electric lighting by means of vacuum tubes and that most promising results have already been obtained as to light without heat.

THE PHILADELPHIA INSTITUTE MEETING.

In interest, earnestness, enjoyment and success, no convention within our experience has excelled that with which the American Institute of Electrical Engineers celebrated in Philadelphia last week the completion of its first decade and the prosperous beginning of its second. It is a curious coincidence that Prof. Houston, who has the honor of having the first paper appear in the first volume for the first annual meeting, in 1884, should also open the list again in 1894 with his admirable address, which was not only a review of the past, but a programme for the future.

The Institute has done much good work. It will also do a great deal more, and in this it will be helped by the kindly criticisms and suggestions of its friends fully as much as by the rapid increase in its membership now going on from all parts of the country. The high appreciation in which it is held was notably manifested in the royal hospitality extended to it last week in Philadelphia, and by the remark from more than one visitor that he hoped the Institute would favor his city in 1895.

INSTRUCTION IN ELECTRICAL ENGINEERING.

The Electrical Engineer will shortly begin the publication, under the title *Electrical Engineering Leaflets*, of an important educational work, written by Professor Edwin J. Houston and Mr. A. E. Kennelly. The Leaflets will be issued weekly, in three grades—Elementary, Intermediate and Advanced—each grade consisting of thirty-five weekly parts, all three to issue simultaneously. The Elementary series is adapted to the needs of electrical artisans, linemen and beginners of the study of Electricity. The Intermediate grade will be useful to students in high schools and colleges, and to all workers who shall have studied the Elementary grade, or who, through their knowledge or experience, are already acquainted with the rudiments of Electrical Engineering. The third, or Advanced, grade is intended to serve college or university classes in technical courses as well as the rapidly increasing number of practical engineers who desire to keep pace with advancing scientific knowledge and theory. General readers interested in scientific and industrial progress will find interest in any or all grades of the Leaflets, according to their familiarity with the subject of Electrical Engineering. The topics treated will be substantially the same in all of the three grades; the treatment varying, as indicated in their designations—Elementary, Intermediate and Advanced.

A prospectus of the work will presently be issued, giving a schedule of the topics covered, and prices of single copies and of subscriptions for the series.

The peculiar and preëminent qualifications of Professor Houston and Mr. Kennelly for the preparation of a course of electrical instruction will be generally recognized. Professor Houston is not only identified with the electrical engineering and invention of recent years, but has had nearly a quarter of a century's experience in teaching physical science; and it is not too much to say that Mr. Kennelly stands easily in the front rank of practical and mathematical investigators in the fields of electrical theory and practice.

COST OF NIAGARA TRANSMISSION.

The admirable article by Messrs. Houston and Kennelly in our issue of May 2, in which they take up the question of the distance to which Niagara water power can be economically transmitted, has attracted wide attention not only in electrical engineering, but in lay circles as well, as evidenced by the numerous references thereto in newspapers throughout the country. We have received quite a number of communications on the subject from well-known electrical engineers, but press of other matter permits us to print only that of Dr. Charles E. Emery in this week's issue. It will be noted that Dr. Emery differs somewhat from the conclusions reached by Messrs. Houston and Kennelly and places the limits of economical working at a considerably shorter distance than do they.

ELEVENTH ANNUAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The American Institute of Electrical Engineers held its eleventh annual meeting in Philadelphia, May 15, 16, 17 and 18, at the Engineers Club. The sessions began at 10 A. M., on the 15th, President Houston in the chair. An address of welcome was delivered by Mayor Stuart, and Mr. John C. Trautwine, president of the Engineers Club also welcomed the members.

Those present were :—

Philadelphia.—C. R. Arnold, A. E. Braddell, J. G. Biddle, C. A. Bragg, C. Billberg, A. E. Childs, W. E. Culbertson, W. J. Cheney, J. M. Dodge, F. W. Darlington, W. P. Dallett, W. A. Drysdale, W. C. L. Eglin, F. R. Ford, H. P. Farrington, S. G. Flagg, Jr., J. P. Gaylord, T. W. Glading, R. M. Hunter, J. Hoskin, G. H. Harris, F. H. Hochrath, E. J. Houston, C. Hewitt, Carl Hering, S. C. Ingalls, J. D. Israel, A. L. Johnston, F. L. Knight, R. H. Klauder, A. E. Kennelly, E. R. Keller, Minford Levis, E. K. Landis, A. P. Mayers, W. D. Marks, G. B. Price, L. K. Perot, C. W. Pike, A. L. Register, A. J. Rowland, E. A. Scott, E. T. Stewart, F. E. Swope, Jr., J. F. Stevens, F. Sheble, T. Spencer, L. N. Schultz, C. W. Swoope, J. C. Trautwine, Jr., J. F. Uhlenhaut, Jr., E. G. Willyoung, H. P. White, C. P. Wilson, P. Wright, C. J. Reed, F. A. La Roche.

New York City.—Harold Binney, C. S. Bradley, F. R. Colvin, F. B. Crocker, S. L. Coles, H. S. Chase, G. S. Dunn, H. M. Davis, C. E. Emery, J. Hamblet, C. T. Hutchinson, W. R. Hewitt, W. F. Hanks, W. J. Hammer, W. J. Johnston, J. M. Knox, A. A. Knudson, W. B. Lester, H. W. Leonard, R. McA. Lloyd, O. T. Louis, G. R. Metcalfe, W. A. Mosscrop, T. C. Martin, P. R. Moses, W. F. Osborn, J. W. T. Olan, N. W. Perry, R. W. Pope, G. M. Phelps, R. Pfund, M. I. Pupin, C. T. Rittenhouse, H. D. Reed, J. Sachs, L. Stieringer, T. R. Taltavall, H. C. Townsend, W. D. Weaver, N. D. Webster, J. Wetzler.

Schenectady.—T. V. Bolan, H. G. Reist, C. P. Steinmetz, F. W. Tischendoerfer, A. E. Wiener.

Baltimore.—L. Duncan, J. C. George, H. S. Hering, J. W. McCrosky, A. Reber, F. McS. Thomas.

Ansonia.—G. G. Grower.

West Chester, Pa.—A. Hoopes.

Orange, N. J.—F. R. Upton.

Camden, N. J.—W. E. Harrington.

Frankfort-o-M., Germany.—Fried. Cornell.

Maywood, N. J.—C. L. Jaeger.

Vineland, N. J.—W. A. Anthony.

Virginia.—W. E. Anderson.

Newark, N. J.—R. O. Heinrich.

Lincoln, Neb.—R. B. Owens.

Ithaca, N. Y.—F. Bedell, H. J. Ryan.

Cleveland, O.—C. N. Black.

Pittsburgh.—E. E. Keller, C. F. Scott, A. J. Wurts.

Brooklyn.—F. B. Corey, A. B. See.

St. Paul, Minn.—M. H. Gerry, Jr.

Bridgeport, Conn.—L. Waldo.

Passaic, N. J.—S. D. Mott.

State College, Pa.—J. P. Jackson.

Haverford, Pa.—W. W. Griscom.

Rutherford, N. J.—A. Buys.

Hartford, Conn.—F. G. Waterhouse.

East Orange, N. J.—J. P. Jackson.

West Hoboken, N. J.—Fred. Reckenzaun.

Wilmington, Del.—J. L. Hall, C. R. Van Trump.

Pittsfield, Mass.—Wm. Stanley, Jr.

Minneapolis.—Morgan Brooks.

Manchester, Conn.—J. Waring.

Troy, N. Y.—E. G. Bernard.

Messrs. F. R. Upton and G. R. Metcalfe were appointed tellers of the ballots for officers.

Several slight changes were made in the Rule 5, governing elections, in the direction of great explicitness and more opportunity to members in good standing to record their votes under the balloting system now in force.

The reports of Secretary Pope and Treasurer Phelps were received and accepted. The treasurer's report showed a total income for the year ending April 30, of $10,499.50. The balance in his hands was $407.54. The special World's Fair Fund had raised $1,148, and expended $1,331. The sum of $351 had been received towards the expenses of issuing the report of the Electrical Congress of 1894.

The Secretary's report mentioned the adoption during the year, of an official badge, and of a certificate of membership. The success of the headquarters at the World's Fair was referred to, and it was pointed out that the work of the Institute had been very useful in the preliminary arrangement of the Electrical Congress programme. The necessary number of 400 subscriptions to the Congress book had already been pledged, and it was expected to have the volume ready in September. Should there be any profit, it might be applied to the small deficit on the World's Fair fund. The report also referred to the great success already secured by the local meetings of the Institute in Chicago. The following table shows the growth of the Institute in membership during its ten years of existence, there being now just 800 members in good standing, with others about to qualify :—

1884	154	1889	118
1885	14	1890	116
1886	11	1891	100
1887	152	1892	96
1888	70	1893	165
			991

The Institute also has $905 accumulated towards a Building Fund. The Secretary reported that the financial depression had made collections slow, but that the growth of the Institute during 1893 had nevertheless been the largest yet shown in any year.

A vote was passed by the meeting of $10 towards the expenses of each meeting of the Chicago section.

A resolution was adopted favoring the legalization of the units adopted as a standard at the Electrical Congress; and a memorial to the effect will be addressed to Congress in the usual way.

The Chair announced invitations to visit Girard College, the new power station of the Philadelphia Traction Company, Drexel Institute, Franklin Institute, Historical Society, Schuylkill Navy Club, Germantown Electric Light Company, University of Pennsylvania, the LaRoche Electrical Works and Queen & Co.'s show rooms.

The session in the afternoon began with the announcement of the election of the following officers: President, Professor *Edwin J. Houston*; Vice-Presidents, *W. A. Anthony*, Vineland, N. J.; *F. B. Crocker*, New York; *James Hamblet*, New York, P. B. Delany, H. Ward Leonard and W. Wallace; Treasurer, George M. Phelps, New York; Managers, Charles Wirt and Angus S. Hibbard, Chicago; Dr. Michael I. Pupin, J. J. Carty, Wm. S. Hammer, *W. D. Weaver*, *W. B. Vansize* and *C. S. Bradley*, New York; *A. E. Kennelly* and Charles Hewitt, Philadelphia; Charles P. Steinmetz, Schenectady, N. Y.; and Professor Harris J. Ryan, Ithaca, N. Y.

The names in italic are those of the newly elected members of council; those in Roman are those of the "holdovers" with unexpired terms or re-elected. President Houston was re-elected, the presidential office being for one year only, but its incumbent being eligible for re-election. The secretary is appointed by the council.

The annual address delivered by President Houston, at the the conclusion of the vote was entitled: "A Review of the Progress of the American Institute of Electrical Engineers." (See page 452, this issue.)

Following President Houston's address Professor William A. Anthony, of Vineland, N. J., read a paper on "Light Distribution and the Use of Lamps." (See page 450, this issue.)

A reception was tendered to the members of the Institute and their wives and daughters at the Manufacturers' Club, in the evening, by the Engineers' Club and the Electrical Section of the Franklin Institute. The rooms of the club were tastefully decorated, a handsomely arranged electrical display being an especial feature. Music and a collation were also provided, and the evening closed with dancing.

The Reception Committee comprised the following: Mr. Arthur Falkenau, Chairman; Mr. John L. Gill, Jr., Mr. John Birkenbine, Mr. Edward K. Landis, Mr. Henrik V. Loss, Mr. M. H. Harrington, Mr. Elmer G. Willyoung, Mr. Clayton W. Pike, Mr. Edwin R. Keller, Mr. C. O. C. Billberg, Dr. W. H. Wahl, Mr. George Burnham, Jr., Mr. Frank R. Tobey, Mr. Walter Wood and Mr. James Mapes Dodge.

WEDNESDAY SESSIONS.

The morning session of Wednesday was devoted to the reading of a paper on "Some Storage Battery Phenomena," by Mr. W. W. Griscom, and one on "Discriminating Lightning Arresters and recent Progress in Means for Protection Against Lightning" by Mr. A. J. Wurts. (See page 458, this issue.)

At the afternoon session papers were read by Prof. F. B. Crocker on "Unipolar Dynamos for Electric Light and Power;" "Alternating Currents and Fuse Wires," by Prof. D. C. Jackson and Mr. R. J. Ochsner; "Test of Closed Coil Arc Dynamo" by Prof. R. B. Owens and "The Relative Advantages of Toothed and Smooth Core Armatures" by Mr. Alton D. Adams.

On Wednesday evening the annual dinner of the Institute took place, at the Hotel Metropole, when nearly 100 members and friends sat down, under the presidency of Prof. E. J. Houston, who made an admirable toastmaster. The speeches were as follows: "The Electrical Press," Mr. George M. Phelps; "Commercial Electrical Engineering," H. Ward Leonard; "Mathematics and Electricity," A. E. Kennelly; "the Philadelphia Committee," Mr. E. G. Willyoung; "Electrical Engineering Education," Dr. M. I. Pupin; "Electricity and Time," Mr. James Hamblet; "Power Transmission," Mr. C. F. Scott; "Electricity in the West," Prof. R. B. Owens; and "the Electrical Expert," Prof. W. A. Anthony. It was not until nearly 1 o'clock that the party broke up.

In the meantime, a theatre party for the ladies had been very successfully carried through, and the clever performance of John Drew in "The Butterflies" had been greatly enjoyed at the Broad street theatre. Altogether, the festive celebration of the Institute's tenth anniversary was an occasion of pleasure long to be remembered.

THURSDAY.

Thursday morning session was devoted to the reading of the following papers;

10. "The Waste of Zinc in Open Circuit Batteries when Standing Idle," by Mr. Henry A. Lardner, of Madison, Wis. 11. "Standardizing Electrical Measuring Instruments": (*a*) by the Potentiometer Method; (*b*.) an Improved Direct Reading Potentiometer," by Mr. Elmer G. Willyoung, of Philadelphia. 12. "An Optical Phase Indicator and Synchronizer," by Prof. George S. Moler and Dr. Frederick Bedell, of Ithaca, N. Y. 13. "A New Method of Recording any kind of Variable Current," by Prof. Albert C. Crehore, of Hanover, N. H.

Luncheon was provided for the ladies at the Manufacturers' Club at 12, when they were received by a local committee of ladies. After lunch they boarded Tally Ho coaches and proceeded to Indian Rock Hotel, where a collation was served. The coaches then returned to the Hotel Metropole after a most enjoyable afternoon had been spent.

For the masculine portion of the convention, an excursion was provided to Cramp's celebrated shipyard, a big special boat being in attendance. Lunch was served al fresco as the boat made the run up the Delaware, and from 2 to 3 hours were spent in the yard, which has an area of 31 acres and a water front of 1308 feet; 5,000 men are employed. There are now under construction ships representing 147,000 tons and 236,000 I. H. P. The Cramp yards have built 282 vessels since 1830, and are now busy on several men-of-war and two fine steamers for the American International Line. The visitors wandered at will inspecting everything freely, especially the new cruisers and battleships. Supt. Hartley of the yard was very kind and attentive. The electrical plant includes 3,000 incandescents, about 150 arcs and several motors.

Taking boat again the party proceeded down the Delaware to Gloucester, where they landed, were duly photographed, and then took a spin on the trolley road of the Camden, Gloucester & Woodbury road, recently described in The Electrical Engineer, (see issue of Jan. 3, 1894). Returning from the trip, the power house was inspected, and then all assembled for a planked shad dinner, which was not only an entire novelty to nearly all the strangers, but was deliciously cooked and most satisfying. When the coffee was served, the out-of-town members took things in their own hands and organized a series of off-hand toasts, the responders to which were asked to say nothing serious. They all succeeded to admiration. Mr. T. C. Martin officiated as toastmaster and called up the following: Dr. C. E. Emery "Steam Engineering and Other Kinds;" Sec'y Pope as "the Marquis of Salisbury;" Prof. E. J. Houston as a tired president ready to give himself a rest and "His Automatic Mouth" (poem) a chance; Mr. J. C. Trautwine for the extremely "Civil Engineers;" Mr. John Birkenbine, for the prolific "Mining Engineers;" Prof. F. B. "Croker" as the visiting Institute politician with a complaint to make; Mr. Oberlin Smith, for the engineer, as a gentleman and a Mechanial Engineer; Mr. C. Bragg as an "Engineer of Shad Dinners;" Mr. C. P. Steinmetz, to explain how the Institute had successfully transmitted its power 1,000 miles to Chicago, with 150 per cent. efficiency; and Mr. Falkenau, of the Engineers' Club of Philadelphia, to apologize for having clubbed the members so vigorously and effectually. Each of these gentlemen delivered very neat five minute speeches in 2¼ minutes each, and the tables were in a roar from start to finish. Then the moon rose, and the boat made a delightful return trip around into the Schuylkill, reaching the city about 9.30 p. m.

FRIDAY.

The following papers were scheduled for Friday morning, and in spite of the fact that it was the fourth day of a busy convention, the attendance was large and the discussions were most interesting and brilliant: "Resonance Analysis of Alternating and Polyphase Currents," by Prof. M. I. Pupin. "Some Facts about Polyphase Motors," by Dr. Louis Bell. "The Law of Hysteresis (Part 3) and Calculation of Ferric Inductances," by Mr. Charles Proteus Steinmetz. "Experiments with Two-Phase Motors," by Dr. Louis Duncan.

It was not until nearly 3 p. m. that the discussions closed, whereupon some 40 or 50 members made a bee "trolley" line for the La Roche Electrical Works in the outskirts of the city, where Mr. F. A. La Roche and his staff were in waiting with a remarkably good, and not less welcome lunch. Mr. La Roche addressed a few modest, well chosen remarks to his guests, who responded very cordially; and after the cigars and coffee the party dispersed over the works and were given an excellent opportunity to see all classes of direct and alternating current apparatus in process of construction, as well as of inspecting some machines of old types which have been sent to Mr. La Roche for his diagnosis as to their reconstruction or repair. While Mr. La Roche did not feel at liberty to show all his latest productions, in the experimental floors, his polyphase machines now building were evidence of the fact that he was in touch with the latest practical developments of the art. Some instruments were also shown, made by the Keystone Instrument Co. under Mr. La Roche's patents. Altogether a most pleasant and instructive afternoon was spent, and the Philadelphia meeting thus came to a very happy ending.

Before closing its meetings, the Institute passed hearty votes of thanks to all its entertainers, not forgetting those upon whom, owing to lack of time it was not able to call in a body. Besides the invitations already mentioned and accepted, others of equal hospitality came from the Philadelphia Edison Co., the Chloride Accumulator Co., the Philadelphia Traction Co., the Germantown Electric Light Co., the Brill Co., and Queen & Co.

Many thanks were extended to the local committee for its unremitting courtesies to the ladies, and the general belief was expressed that the next annual meeting will see a much larger representation of the fair sex. But any other city will have to work hard to eclipse Philadelphia in hospitality.

At the meeting of the Council on May 15, at Philadelphia, the following gentlemen were admitted to associate membership:

Berresford. Arthur W., B. S. M. E., Electrician, Brooklyn City R. R. Co., 197 Van Buren St., Brooklyn, N. Y.; Bijur, Joseph, Student in Electrical Engineering, Columbia College, Residence, 41 West 53rd St., New York City; Chadbourne, Henry R., Jr., Electrical Engineer, Troy City Ry. Co., Troy, N. Y.; Childs, Sumner W., Supt. of Line Construction, J. G. White & Co., 1425 Maryland Ave., Baltimore, Md.; Clark, LeRoy, Jr., Post-graduate Student in Electrical Engineering, Columbia College, 350 West 30th St., New York; Doolittle, Clarence E., Manager and Electrician, Roaring Fork Electric Light and Power Co., Aspen, Colo.; Dorr, Frank H., Engineering Dept. General Electric Co,. 425 Baker St., San Francisco, Cal.; Glading, Frank W., Lehigh University, 2005 East York St., Philadelphia, Pa.; Hartwell, Arthur, Electrical Engineer, Westinghouse Electric and Mfg. Co., Pittsburgh, Pa.; Haviland, Foster L., with Clark Electric Co., 192 Broadway, Residence, 163 St. Nicholas Ave., New York City; Hewitt, William R., Special Student, Electrical Dept. Columbia College; 130 E. 60th St., New York City. Residence, San Francisco, Cal.; Holberton, George C., Electrical Engineer, General Electric Co., 15 First St., San Francisco, Cal.; Morse, George H., Assistant Instructor in Electrical Engineering, University of Minnesota, Minneapolis, Residence, Excelsior, Minn.; Nicholson, Walter W., General Sept. Central N. Y. Telephone and Telegraph Co., 73 Howard Ave., Utica, N. Y.; Philbrick, B. W., Electrician, in charge of Electrical Plant, Levi P. Morton, Rhinecliff, N. Y.; Ricker, Charles W., Expert Electrical Engineer, 109 White Building, Buffalo, N. Y.; Sharp, Clayton H., Instructor, Department of Physics, Cornell University, 122 University Ave., Ithaca, N. Y.; Stine, Prof. Wilbur M., Director Electrical Dept., Armour Institute, Chicago, Ill.; Tower, George A., Electrical Engineer, The Sherwood Land Co. and The Jefferson Hotel Co., 109 S. First St., Richmond, Va.; Wharton, Hugh M., Electrical Engineer, Westinghouse Electric and Mfg. Co., 29 Plane St., Newark, N. J,; Winchester, Samuel B., Supt. and Electrician, Holyoke Water Power Co., 9 Laurel St., Holyoke, Mass.

The following applications for transfer from associate to full membership were approved:

Lorrain, James Grieve, Norfolk House, Norfolk St., London, W. C., England; Wiener, Alfred E., Electrical and Mechanical Engineer, General Electric Co., 24 Yates St., Schenectady, N. Y.; Craigin, Henry A., Engineer, Westinghouse Electric and Mfg, Co., 15 Charles St., Boston, Mass.; Hasson, W. F. C., Consulting Engineer, 104 Sutter St., San Francisco, Cal.; Ives, Edward B., Lieutenant U. S. A., Electrical Engineer, 11th and Colona Sts., Philadelphia, Pa.

A PROPOSED CANADIAN ELECTRIC RAILWAY.

Messrs. J. B. La Liberté, J. U. Gregory, B. Leonard, P. B. Dumoulin, J. F. Guay and F. M. W. Pampalon, all of Quebec, are applying for letters of incorporation under the name of "La Compagnie de Tramways Electriques de Quebec" to construct and operate an elevated or surface tramway driven by electricity or other motive power, from a point in or near the city of Quebec to another point in or out of the city of Quebec, but no farther than five miles of its limits. The capital stock of the company is $200,000 and the head office is to be in Quebec.

The Lewis Electric Co.'s method of generating current from a small machine on the car axle has been applied on the Brooklyn Bridge with very encouraging results. One of the cars is lighted in this manner with 16 lamps, and the public appears greatly pleased. The apparatus under the car, the storage cells, and the automatic devices are all working admirably.

DISCRIMINATING LIGHTNING ARRESTERS, AND RECENT PROGRESS IN MEANS FOR PROTECTION AGAINST LIGHTNING.[1]—I.

BY ALEXANDER JAY WURTS.

PART I.—AN EXPERIMENT WITH LIGHTNING ARRESTERS ON A 3,000-VOLT ALTERNATING CURRENT CIRCUIT.

During the winter of 1892 and 1893 I made a searching investigation of this subject, experimenting with disruptive discharges and various kinds of combinations of apparatus which might promise advantageous results, and since that time have spent nearly six months in the State of Colorado—a land of thunder storms—testing the various forms of apparatus which I had designed as a possible protection against lightning.

The general requirements of efficient lightning arrester apparatus are: First. To provide discharge circuits which shall operate automatically and repeatedly, and which shall with certainty avoid dynamo short-circuits or interruption of the system. Second: To provide discharge circuits, or so install them that they shall invariably offer a certain path to ground for disruptive discharges in preference to any other part of the system. It follows also from this last, and as a matter of practical experience, that ground discharge circuits should be short and straight, and that ground connections should be of the most approved construction. Experiments were, therefore made to determine the number of non-arcing metal cylinders and spark gaps which would be necessary to interrupt a short-circuit on a 3,000-volt alternator with the potential raised to 3,300 volts. Nineteen cylinders, or 18 gaps, were found to offer ample margin, and the breaking down E. M. F. on half this number of gaps, which would intervene between line and ground, was found to be about 70 per cent. of the E. M. F. required to break down insulation ordinarily used in a 3,000-volt generator. These experiments will be more particularly described in Part II. The form finally adopted was that of a flat coil about 18 inches in diameter, and wound with 17 turns of wire; the size of the wire varied, of course, with the carrying capacity of the particular circuit into which it was to be connected. After further experimenting with various combinations of spark gaps and choke coils, it was decided that the trial apparatus could consist of eight choke coils and twelve 1,000-volt non-arcing metal arresters for each end of each circuit; that is, four choke coils should be connected in series in each leg of each circuit, with discharge circuits intervening. The relative positions of these parts are clearly indicated in Fig. 1, which represents one end of each of three circuits. Disruptive discharges form nodal points in the system, that is, points where there will be a minimum tendency to discharge; hence, to avoid these with any degree of certainty a multiplicity of arresters, preferably line arresters, should be used. Choke coils form points of reflection, or points where there will be a maximum tendency to discharge—hence a discharge spark gap connected directly in front of a choke coil is more likely to receive discharges than if placed at some other point in the system. Disruptive discharges are liable to divide and follow several paths, being governed by a complexity of ever varying circumstances. For this reason it was decided to connect several choke coils in series, so that should only a portion of a discharge pass across the first arrester, the balance passing through the first coil, a second opportunity for discharge would be found at the second arrester, which was also connected in front of a coil, and, therefore, at a point of reflection. Should this remaining portion of the discharge again divide, a further oportunity for discharge would be afforded at the third arrester, and so on, so that by the time the fourth coil was reached it was presumed that the discharge would have spent itself.

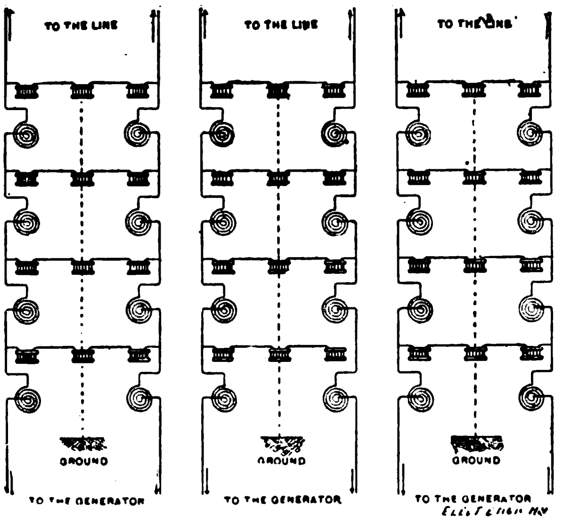

FIG. 1.

Some of the many experiments made to substantiate this theory are exceedingly interesting as well as instructive. Referring to Fig. 2, A are the terminals of a powerful influence machine, B is a battery of Leyden jars, G a wire which may represent the ground, and is connected to the outside coating of the jars, L is a second wire which may represent one leg of an electric circuit; *a*, *b*, *c* and *d* are choke coils connected with the line L, and in series with each other; 2, 3, 4, and 5 are intervening discharge circuits containing spark gaps; 1 is a 12-32 inch spark gap separating line L from the inside coating of battery B. If now the battery becomes charged from the influence machine A, a large and violent disruptive discharge will take place across gap 1 and suddenly charge line L. This discharge will then pass to earth G through one or more of the spark gaps 2, 3, 4, 5, according to circumstances. It will be noted now, that this arrangement of choke coils and discharge circuits is similar to that shown in Fig. 1. The spark gaps were made of rounded half-inch brass rod adjustable with a 1-32-inch screw thread. The coils were wound with No. 0000 wire, were 3 inches in diameter, 6 inches long and contained 11 turns each.

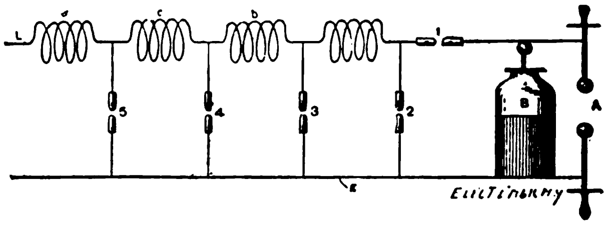

FIG. 2.

With these four choke coils in series and spark gaps intervening, the discharges are so thoroughly sifted out that only an occasional thread-like spark finds its way across the last gap. With laboratory results such as these, it seems fair to presume that results more or less similar might also be expected in practice.

The plant selected for the trial of this apparatus was that of the San Miguel Consolidated Gold Mining Company, of Telluride, Colorado, which is equipped with a 3,000-volt alternating current synchronous system, of 1,100 h. p. capacity, operating stamping mills, and furnishing current to the Telluride Electric Light Company. These points are situated among the mountains at distances varying from three to ten miles from the power-house. Three separate circuits leaving the power-house, extend over a wild and rocky country and in some places rise above timber line. In previous years every attempt to protect this plant from lightning had failed. During the summer months two horses were kept constantly saddled ready for emergencies consequent on lightning discharges, and at the motor and power-house it was common practice on the approach of a thunder storm to lay out, ready for instant use, an extra armature coil, with all the necessary tools for handling the same. In one of the former types of arresters used in this plant forty fuses were blown inside of 60 minutes.

The apparatus was then installed in a specially constructed and weather-proof lightning arrester house, the arresters and choke coils being mounted on thoroughly dried wooden frames and every precaution taken to insulate these from the ground and from each other. In this manner also it was expected that the lightning discharges would be kept entirely out of the station. The connections inside the power-house lightning arrester house are all clearly indicated in Fig. 1. One main B. and S. No. 3 ground wire was used for all the arresters in each bank, unnecessary kinks and bends being studiously avoided.

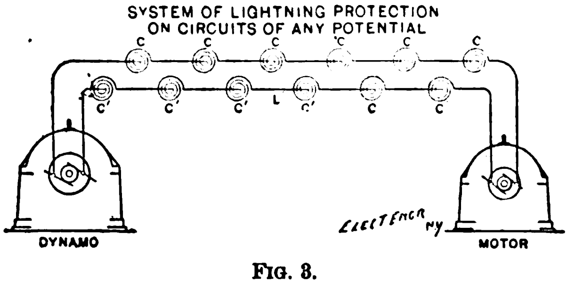

FIG. 3.

Observations were taken by competent men at each bank of arresters during the entire lightning season, and the results obtained indicate that the discharges occurred most frequently over the second arresters; many passed over the third arresters; very few, however, over the first or fourth. The writer personally watched one of these banks of arresters through severe thunder storms and in every instance the discharges noticed by him were seen to pass across the second series of spark gaps, but in no instance was there a fuse blown or damage done to the arresters.

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[1] Abstract of a paper read at the Eleventh General Meeting of the American Institute of Electrical Engineers, Philadelphia, May 15th, 1894.

PART II.—PROTECTION AGAINST LIGHTNING ON CIRCUITS OF ANY POTENTIAL.

A system of protection against lightning discharges has been designed by the writer, which is applicable to circuits of any potential, and although this system has not yet received a practical test, the indications are that it will prove efficient.

The proposition is to connect in series with the circuit, and at frequent intervals, a system of properly constructed choke coils, the expectation being that the energy stored in the circuit in the form of static electricity will, at moments when there is a tendency to a disruptive discharge, dissipate itself into heat through the electrical surgings which will be set up between and among the several choke coils. In Fig. 3 there is represented a power transmission circuit provided with this system of protection against lightning.

Now, if the "electrical surgings" theory be correct, I believe that the dangerous points of reflection can, by means of properly distributed and effective choke coils, be confined to long lines and made to wear themselves out, as it were, between the coils. In this manner frequent points of reflection would be distributed over the system. Primary waves set up during electrical disturbances would be broken into smaller waves, which, surging back and forth between the coils or points of reflection, would finally become dissipated and their energy pass off into heat.

The number of coils which it would be necessary to use for a given length of circuit has not yet been determined, but the writer would suggest placing four to each mile of single wire. For convenient accomodation on the poles these can be arranged alternately on the two legs of the circuit, thus avoiding two coils on any one pole.

Should such a system of protection against lightning be found efficient, its many advantages over the discharge circuit method would be obvious, particularly in a country where good ground connections are costly, and often impossible to construct.

The general form and dimensions of these choke coils is a matter of considerable importance. Dr. Lodge states, I believe, that for disruptive discharges a flat spiral will offer maximum impedance with a given length of wire. To the best of my knowledge, however, Dr. Lodge makes no mention of the number of turns which may be advantageously used. I have found by experiment that the impedance does not continuously increase with the number of turns, but that a critical point is rapidly reached, beyond which additional turns do not add appreciably to the impedance of the coil. The impedance does not increase beyond the 17th turn.

Dr. Lodge has also experimented with such coils in connection with iron cores, and found that the impedance is not appreciably affected by their introduction. I have also experimented in this line, and have naturally surprised myself by obtaining quite different results. It is, however, to be supposed, in view of Dr. Lodge's masterly study of this subject, that my conditions have in some way differed from his. I found that upon the introduction of a small bundle of iron wires into the core of a coil, the impedance to disruptive discharges was reduced nearly 20 per cent. The cause of this was at once made apparent by the beautiful sparks which were seen to appear among the iron wires of the core upon the passage of each disruptive discharge. These iron wires, of course, form among themselves closed secondaries to the primary coil, and in this manner also very beautifully illustrate the oscillatory character of the discharge.

CABLES OBSOLETE IN SAN FRANCISCO.

THE CONSOLIDATED PIEDMONT CABLE COMPANY has abandoned the use of its cables on all portions of the road except the hill section from the cable house to Piedmont. Electric cars have been substituted on the Broadway and Cemetery branches. The change of plans has cost the stockholders in this country a round sum early and late. The line as originally projected included a cable on Fourteenth street. Several thousand dollars was expended in excavating for the transfer wheels in front of the City Hall and large winders were purchased, all of which became a dead loss when it was decided to build an electric system. The cemetery branch has not been in operation more than three years, and all the expense of construction for cable might have been saved if electricity had been adopted in the first place. The present change is made by the receiver under a permit by the Superior Court.

RELATIVE ADVANTAGES OF TOOTHED AND SMOOTH CORE ARMATURES.[1]

BY ALTON D. ADAMS.

THE merits of different methods of construction in the manufacture of dynamo electric machinery, as in other lines, must evidently be decided by their comparative costs, all else being equal. Although questions concerning the relative merits of toothed and smooth core armatures have long been discussed, very little seems to have been written, to show whether actual saving in cost may be effected by one construction over the other, when employed to produce the same results.

The practice of dynamo builders in this country, and abroad, embodies both types, and the history of the art records many changes from each to the other. In view of the above, the inquiry, whether in the light of present facts any saving can be effected by the use of toothed core armatures, seems of interest.

The limits of this paper do not permit consideration of this question in connection with all classes of electrical machinery, and its bearing on direct current constant pressure machines only will be taken up.

The principal disadvantages of toothed, compared with smooth core armatures, are greater first cost, large change of lead, excessive sparking, when used with too short air gaps, and the production of heat in pole pieces; their advantages are, that inductors are positively driven, large solid inductors, protected from eddy currents, and that a reduction may be made in the length and consequent magnetic resistance of the air gap.

Change of lead may be fixed within any desired limits, and sparking abated by such proportions of air gap and teeth, as give them sufficient magnetic resistance.

Heat in pole pieces may be reduced by their lamination, by the use of very narrow teeth and slots, by forms of teeth that present a nearly continuous surface of iron to the pole pieces, and still more, by the use of openings in core discs which do not cut through their outside surface, or a continuous magnetic sheath outside the teeth.

For any given form of tooth, the heating of pole pieces is less, the longer the air gap.

The mechanical strength of armature teeth, as usually employed, is far in excess of that required to hold inductors in position, even under conditions of short circuit, and driving pins inserted in the core, at proper intervals, are much cheaper and take up less valuable room on the armature circumference.

Either teeth or substantial driving pins are, of course, preferable mechanically to the slender bits of hard fibre which have been much used, and frequently give way under the heavy strains to which large generators are subject.

When large wires or copper rods are used as inductors, their protection from eddy currents is an important matter, but proper stranding of inductors reduces the eddy loss in them, when used on smooth cores, to a very small amount, and has the further important advantage that inductors may be bent into the proper shape at armature ends, and the joints, necessary when rods are used, avoided.

The chief possible advantage, then, to be gained by the use of toothed armatures, is through a reduction in the length of the air gap, and the consequent reduction in the ampere turns required on field magnet, weight of copper, or energy in winding, and the length and weight of iron core. To make this advantage available, it must be practical to use air gaps shorter than are required for insulation, winding and clearance.

As is well understood, the armature winding of a dynamo or motor, in operation, has a magnetizing action which is measured in ampere turns for a bipolar machine, by one quarter the product of all the inductors of the armature, into the total armature current. The ampere turns on the armature evidently tend to set up a flow of magnetism, having a complete circuit through the armature core, twice across each air gap, and through the iron of pole pieces.

About half the ampere turns furnished by the inductors under pole pieces, evidently act against the field ampere turns in each air gap at the polar tips, and the ratio between the armature and field ampere turns at this point, necessary to give sparkless reversal there, must determine whether the required magnetic resistance be greater or less than that of an air gap long enough for insulation, winding, and clearance with a smooth core armature.

As an armature coil in an operating dynamo or motor passes under the brush, the current flowing in it must stop, and one in the opposite direction be set up; and if this action is to be accomplished without sparking, a sufficient electromotive force must be provided in the coil while in direct contact with the brush. In the ordinary dynamo or motor, magnetism forced across the path of the coil, by the field ampere turns expended in air gap, must provide this reversing electromotive force.

The data of a number of smooth core armature machines of different make, show ratios of field to armature ampere turns in air gap, of from about one and one-half to one, to two and one-half to one, and the writer's experience is that a ratio of two to one will give sparkless operation at full load, with brushes set just outside pole corners.

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[1] A paper read at the Phila. Meeting, Am. Inst. Elec. Engrs., May 16, 1894.

It is a matter of common experience that the ratio between field and armature ampere turns in the air gap may be so reduced, even in machines with smooth core armatures as to require excessive change of lead to secure even approximate freedom from sparking.

If it be desired therefore to build machines having an expenditure of field ampere turns in the air gap not much greater than those of the armature, we need not resort to toothed cores.

Take, for example, the case of a 260 ampere dynamo, with 120 inductors on its armature in one layer; an air gap induction of 25,000 lines per square inch, and 80 per cent. of inductors under the pole pieces.

An air gap of .45 inch between the armature and each pole piece will be sufficient for insulation, winding and clearance, and the field ampere turns expended in each air gap will therefore be 3,500, while the armature ampere turns, active under each pole tip, will be 3,100.

A considerable change of lead and sparking can be readily predicted for this machine.

In some types of small machines, the room required by insulation, winding and clearance, makes the air gap longer than necessary for sparkless operation, and in such machines the utility of teeth seems to depend on their cost compared with the saving to be effected by their use.

As the ampere turns, furnished by the inductors under any pole piece, grow less in a machine of given capacity when the number of poles is increased, very short air gaps may be used, if the number of poles is sufficiently large.

As an increase in the number of poles usually makes a machine of given capacity more expensive, however, the question at once comes up, to what extent the number of poles may be increased without a greater expenditure than the saving of iron and copper to be effected.

In large multipolar machines of four or six poles, such as are commonly used, the length of air gap required for sparkless operation, is considerable, and those who have watched the development of these machines with toothed core armatures during the last four or five years, have seen the air gaps gradually widen until machines of this character are not hard to find in which the copper inductors between the teeth could be taken out, wound outside the teeth, and still leave room enough for good clearance.

Additional mechanical security, of course, furnishes a considerable argument for the use of teeth in very large slow speed machines.

A number of devices have been suggested from time to time, to enable toothed core armatures to be used with short air gaps, and the consequent saving in iron and copper effected. No machines with these devices, however, have yet stood the test of time and competition with those of ordinary type, and have yet to prove their ability to produce results, as at present attained at a less cost.

The seeming opportunity to save material by the use of toothed armatures is very attractive, and we cannot but hope it may some day be practical; in the light of present knowledge, however, there seems little to be gained by their use in medium and large bipolar machines.

Worcester, Mass., May 9, 1894.

LETTERS TO THE EDITOR.

FIELD EXCITATION.

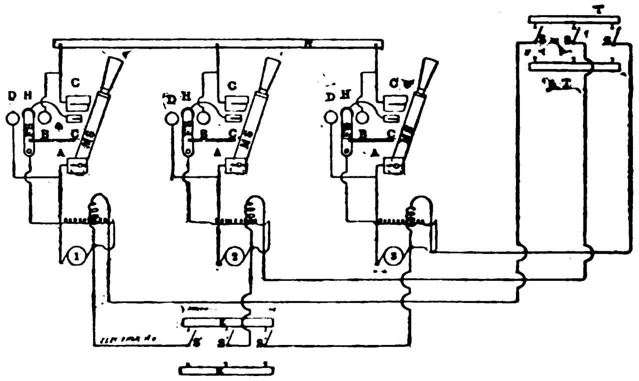
Mr. C. S. Van Nuis' article in your issue of May 2nd, on the above topic, cited from an extract read by the author before the National Electric Light Association at the Washington meeting. Perhaps a full quotation of the original text will put it more clearly, as the extract closed short of the final sentence which reads as follows: "All things considered, the self exciting method of exciting a dynamo field is most applicable in central station practice, especially on low potential systems, and when the main switch of the dynamo is thrown on the busses it is practically bus excited, and we would advise engineers to excite their dynamos in this way as it has proven in practice to be a flexible and simple system."

In the field circuit, complications should be avoided where simplicity would answer. In its action it is analogous to the nervous system, and an accident to this part of the plant, especially where dynamos are run in multiple, will, when a fault develops in this circuit, place a low resistance armature directly across the bus, which, if rotating in a weak field, will run as a motor. Disastrous results may follow, and an expensive unit be wrecked. It would be a good rule to prohibit the introduction of any unreliable contact such as fuses, switches, or poorly soldered connections in the field circuit, and the "Self Exciting Method" more readily meets these conditions of simplicity of circuits and the impossibility of false connections, and also avoids introducing into a system of low potential a high potential discharge.

The field discharge of a small bipolar unit is readily handled and does not require very much attention on the part of the engineer. A bank of lamps across the field terminals, which is thrown into circuit before the field is broken, is the ordinary practice, but with high field intensities and a large time constant, as is found in a large direct driven generator, the stored energy of the field discharge increases enormously the effects noted in breaking the smaller fields. In one case of a multipolar of 400 k. w. output, an arc 6 inches long could be maintained between carbon terminals for one minute while discharging. On suddenly opening this same field circuit the discharge would sound like the report of a pistol.

Prof. Anthony's method, described in your issue of April 11th, of short circuiting the field on the last step of the rheostat is very appropriate for small units, but care should be exercised when advising the use of this method, to ascertain that the current-carrying capacity of the rheostat would be sufficient to carry the full current when placed across the potential of the system. If a lamp, or lamps, were introduced between the third from the last and the next to the last step on the rheostat switch, before short circuiting the fields, the box would in this way be amply protected in case the box was left across the bus pressure of the system. But to open the field current before short circuiting the field terminals would subject the field insulation to a stress which would eventually break it down.

Mr. Van Nuis' method is practically the same as the well-known method of Mr. Donshea of the New York Illum Co., but it does not have all the merits of both bus exciting and self exciting methods, which will become evident if the field switch when in the position shown in the figure on page 392 (here reproduced), is thrown to the right from the centre contact button to the bus exciting terminal of the three pole switch. In this case, the field cannot be taken off of bus exciting until the dynamo is brought up to bus voltage, and if any fault develops and the engine has to be shut down before the dynamo is thrown on the system—then when this occurs, as it often does, the switchboard attendant is helpless and cannot get his field circuit open without introducing a high potential discharge into the system; and this objectionable feature the device shown is supposed to obviate, and for this reason where it has been practically tried has been abandoned, or changed to overcome this objectionable feature.



Van Nuis Method of Field Excitation.

As to Mr. Van Nuis' criticism of Prof. Anthony's method, the same objection he finds in Prof. Anthony's method exists in his own. In the same figure referred to above when the equalizing switch is thrown and there is no current in the field circuit, 500 volts or the bus bar pressure will exist between the adjacent contacts "H" and contact "D," also bus volts between large and auxiliary clip of the special switch shown in the same cut.

Albert B. Herrick.

Schenectady, N. Y., May 10, 1894.

LITERATURE.

La Téléphonie. By Emil Piérard, Liége. 1894. Chas. Desoer. 372 pp. 6 x 9 inches. Price, $3.

In this work the author has sought to give a historical and technical account of the telephone, dealing with it more especially from a practical standpoint. As a result we find descriptions of apparatus, methods of construction, etc., at present in use more particularly abroad, although American apparatus has by no means been neglected. We are glad to note that a description of numerous abandoned types of telephones and switchboards has been omitted. While this has probably reduced the bulk of the work, it has by no means reduced its value for the reader who is looking for information as to the actual state of the art.

LEGAL NOTES.

INCANDESCENT LAMP LITIGATION.

The Edison Electric Light Company, Philadelphia, has brought suits against a number of parties to restrain the use of incandescent lamps said to embody infringements on the Edison patents. The defendants in these bills are: John T. Bailey & Co., the Columbia Electric Light Company, the City of Philadelphia, Girard Trust Company, Brown Bros. & Co., Hood, Faulkrod & Co., Hoopes & Townsend, the Kensington Electric Company, the Pennsylvania Railroad Company, the *Press* Company (limited), the Southern Electric Light and Power Company and the West End Electric Light Company.

Similar suits have been brought in Brooklyn against local concerns, by the local Edison Co.

RAIWAY LITIGATION—JOHN C. HENRY vs. PHILADELPHIA TRACTION CO.

In the United States Circuit Court, May 11, John C. Henry, of Westfield, N. J., filed a bill of complaint against the Philadelphia Traction Company, Peter A. B. Widener, William L. Elkins, David W. Dickson, James T. Gorman and Frederick W. Darlington alleging infringements by the defendants on the plaintiff's three patented improvements in trolley operation.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 15, 1894.

Alarms and Signals :—

Electric Railway Signal, R. M. Strong & C. F. Reed, Omaha, Neb., 519,932. Filed Sept. 5, 1893.

A signal for steam railways indicating within the locomotive cab the condition of the track.

Electric Railway Signal, F. Beattie, Leete Island, Conn., 519,938. Filed Apl. 2, 1894.

Similar in its object to No. 519,932.

Dynamos and Motors :—

Constant Current Dynamo, W. H. Elkins, Cambridge, Mass., 519,858. Filed Feb. 3, 1894.

The chief feature of the invention is that the current through the commutator varies with the load, although it is constant in the work circuit.

Method of and Means for Starting Synchronous Motors, B. G. Lamme, Pittsburgh, Pa., 519,862. Filed Apl. 5, 1893.

Method consists in applying to the armature a starting current of low potential and large volume, causing the armature to excite the field magnets by induction, and then gradually increasing the potential of the starting current to that of the supply circuit.

Electric Mechanism for Giving Reciprocating Motion, H. S. McKay, Boston, Mass., 519,869. Filed Mch. 12, 1892.

Invention relates to a special arrangement of movable and fixed contacts and their connections, whereby the reciprocation of the armature will cause the commutator to alternately energize and short circuit the magnet.

Magnetic Engine for Reciprocating Tools, H. S. McKay, Boston, Mass, 519,870. Filed July 5, 1892.

An electric drill depending for its action substantially upon the mechanism described in 519,869.

Device for Regulating Electricity Generated by Means of Wind Power, T. A. Willard, Norwalk, Ohio, 519,881. Filed Apl. 6, 1893.

Relates to devices for regulating the strength of the current in the field circuit of the generator, so as to obtain a current in the main circuit of stationary pressure without regard to any irregularity in the speed of the windmill.

Lamps and Appurtenances :—

Electric Arc Lamp, W. Mathiesen, Leipsic, Germany, 519,726. Filed May 29. 1893.

Invention relates to the construction of the magnetic regulating device.

Alternating Current Arc Lighting System, T. Spencer, Philadelphia, Pa., 519,849. Filed Feb. 12, 1894.

Claim 1 follows:

The combination with an alternating current arc lamp of means for adjusting the voltage at the lamp terminals to different strengths to adapt the lamp for operation upon circuits of different voltages, and means for lowering the voltage after the lamp has been thrown into action.

Electric Arc Lamp, J. F. Kester, Buffalo, N. Y., 519,912. Filed Oct. 23, 1893.

Employs a magazine carbon holder adapted to consume fragments of carbon.

Measurement :—

Electric Indicator, W. E. Garey, Chicago, Ill., 519,945. Filed Oct. 13, 1893.

The invention relates especially to the construction of the magnet in an electrical measuring instrument, and to the manner of associating the magnet and armature.

Railways and Appliances :—

Electric Railway System, D. Mason, Schenectady, N. Y., 519,794. Filed June 27, 1893.

Claim 1 follows:

In an electric railway system a current main or lead having branch conductors operatively connected with switching levers pivotally secured in alignment with the rails of the track and adapted to be actuated by the wheels of the vehicle, in combination with short sectional conductors or contacts provided with circuit connections for connecting them to the aforesaid branch conductors.

Trolley Wheel, Van Dyke Cruser, Flatbush, N. Y., 519,837. Filed Feb. 13, 1894.

Claim 10 follows:

A trolley wheel having one part movable with the other at a greater rate of speed and serving as a wire-cleaner.

Switches and Cut-Outs :—

Hand Regulator or Switch for Motors, E. E. Keller, Chicago, Ill., 519,715. Filed July 12, 1893.

Electrically Governed Switch, E. H. E. Klatte, Freiburg, Baden, Germany, 519,813. Filed Feb. 29, 1892.

An electric device for operating railroad switches, specially adapted for switch towers.

Telephones and Apparatus :—

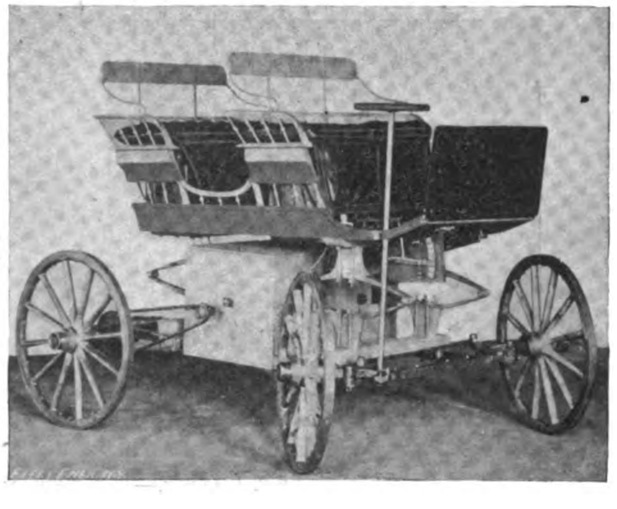
Telephone Circuit, C. E. Scribner, Chicago, Ill., 519,876. Filed Sept. 28, 1893.

Provides means for avoiding the reproduction in a telephone receiver of accidental vibration in its own microphone, without diminishing the efficiency of telephonic transmission.

THE CUMMINGS ELECTRIC CARRIAGE.

While the progress and development in electric street railway and similar appliances in the United States has always been in advance of that in other countries, comparatively little has been done in the line of electrically propelled individual vehicles. The past year has brought us several descriptions and illustrations of electric carriages from France and England, which would seem to indicate that the subject is being agitated there and seriously considered with a view to making the application of such a vehicle commercially practicable. That our electricians and inventors fully realize the value and importance of the subject is evidenced by the fact that from time to time we hear of such a vehicle being designed or "invented," but so far no practical results seem to have been obtained.

During the past few months, Mr. Geo. K. Cummings, a well known electrical engineer of Chicago, has been quietly at work, not only designing an electrically propelled carriage, but building a complete vehicle which he claims to be commercially practicable. The illustration shows a two-seated surrey, capable of carrying four people at a maximum speed of twelve miles an hour on ordinary level city roads. In designing this carriage the inventor seems to have either overcome or avoided the difficulties or obstacles that caused other workers in this particular line to meet with more or less failure. Instead of attempting to produce a vehicle of impractically light weight, Mr. Cummings has kept in view the fact that a carriage for every day use must necessarily be capable of withstanding more or less rough usage without damage to any of its parts, and any vehicle not strong enough to undergo the same treatement as an ordinary carriage receives, must always prove a commercial failure. Such devices, or so-called improvements as rubber tires, bicycle wheels, ball bearings, etc., which theroretically aid traction or lighten the load, when put to ordinary street usage, generally fail to fulfill their promise as improvements over ordinary methods, and at a critical time break down through inherent weakness. The order of improvement is always towards simplicity, hence the best designs are primarily devoid of complications. How well this object has been attained a close inspection of the illustration, coupled with a brief description of the device, will determine.



THE CUMMINGS ELECTRIC CARRIAGE.

A two h. p. 25 volt motor is supported on a light steel frame between the two axles. A raw-hide pinion on the motor shaft drives an intermediate shaft, which through a sprocket chain and wheels transmits motion to the rear or main driving axle. The action is direct and positive, yet the use of the link belt secures a certain flexibility which is very necessary in work of this kind. The front axle is divided into two short movable axles to which the front wheels are attached. To these movable axles the steering device is connected, which seems simple and compact, consisting of a pinion meshing into the gear of the right hand movable axle, the latter in turn being connected by a steel rod with the left hand movable axle. A light wooden box protects the motor from dust and dirt as well as from mechanical injury. One of the chief difficulties heretofore has been to obtain a simple and effective method of applying the driving power to both wheels and at the same time allow each wheel to have an independent speed irrespective of the speed of the axle or other wheel. This is necessary in order that when turning curves or in any manner deviating from a straight course, the outer wheel may travel fast enough to cover the increased distance it has to traverse. This problem has been ingeniously solved by Mr. Cummings through a novel arrangement of a series of five roller clutches applied to each hub. The inventor prefers not to publish the details of this automatic device, but it will be seen that it takes up so little space as to be scarcely noticeable, while it accomplishes its purpose in a very satisfactory manner.

The current to operate the motor is derived from 12 cells of storage battery, six each under each of the two seats. The cells at present in use are of the chloride accumulator type, made by the Electric Storage Battery Co. They have a capacity of 200 ampere hours each, and are supposed to furnish current without recharging for a run of 60 miles. They are connected in series. The speed of the motor is regulated by a rheostat connected in series with the armature. The rheostat lever or contact arm is operated and controlled by means of a treadle directly under the driver's foot. The total weight of the vehicle is given as only 1,270 pounds.

Recent tests of this carriage show that over level city roads at a normal speed of ten to twelve miles per hour, an average of from 1½ to 2 electrical horse power is all that is required, except at starting, the difference in power consumed depending on the state of the road and the style of pavement traversed. The questions of running through the mud, over street car tracks, raised obstructions, such as man-hole covers and the like, starting up out of ruts and gutters, have each been taken up carefully, and through practical experience and actual operation it has been demonstrated that the vehicle successfully and easily overrides such obstacles.

From the above facts it would appear that the operating expense of this vehicle is considerably below that of maintaining a horse; even assuming that one horse would be sufficient to draw the load every day, and that a daily trip of fifty miles be made. Taking two electrical horse power as the average consumed at a speed of ten miles an hour, the total operating expense for current used would be ten dollars per month for a daily trip of fifty miles. This is based upon the published rate of charge for current of the Chicago Edison Co. and would, it seems, put the matter upon a commercial basis at once.

EXHAUST STEAM HEATING.

The American District Steam Company, of Lockport, N. Y., is constructing an underground steam system for the Economy Heat, Light and Power Company, of Scranton, Pa. It will consist of 17,400 feet of mains, under the principal business and residence streets. It is contemplated to use the exhaust steam from the Pennsylvania Iron Company's works, and the street railway or electric light stations. A live steam station will also be constructed with which to regulate pressure, and supplement the supply of exhaust steam during the hours when the electric stations are doing partial work. The longest continuous line of pipe running from the station will be nearly a mile and one-half.

Washington, D. C.—The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up a new Transfer Station for The Washington & Georgetown Railroad Co., at Washington, D. C.

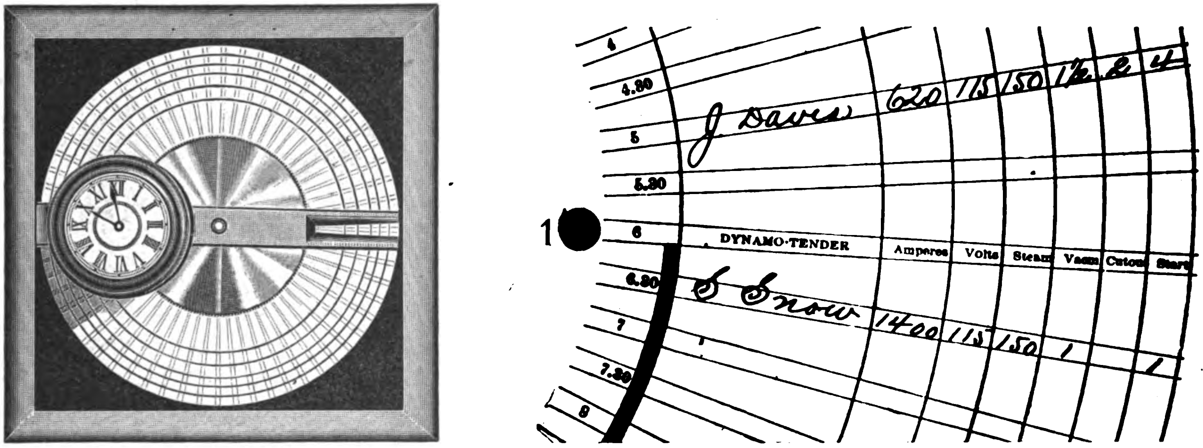
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE AUTOGRAPH TIME RECORDER.

The New National Time Recorder Co., of 192 and 194 East Water street, Milwaukee, Wis., are putting on the market an autograph recorder for electric light and power stations. Fig. 1 represents the device, which is 17 inches square. The clock which drives the record-dial is supported in a casting, the ends of which are securely fastened to the wooden frame. The record-dial is secured inside of the frame under lock and key. A small section of the dial is shown in Fig. 2. It is 15 inches in diameter, and when in operation is entirely covered by plate glass with the exception of an opening ½ x 3½ inches on the right hand side, through which the engineer or dynamo-tender can write his signature and also the record desired. By referring to Fig. 2 it will be seen that the record-dial is divided by parallel radial lines into 30 minute spaces so that a record can be made every half hour of the amperes, volts, steam pressure, vacuum, dynamos cut out and dynamos started, which records are separated by concentric lines. The heavy black line is the night line and represents the time from 6 P. M. to 6 A. M. Fig. 2 shows a record made at 5 P. M. by J. Davis, the day man, and a record made at 6:30 P. M. by S. Snow, the night man. These two records are made simply as an illustration. A dial should show a record every half hour.

The dials are made to cover a space of 30 hours, so that in case whoever keeps the records does not always change the dials at a certain hour each day, there will be six hours lee-way and the records can not be confused. By an ingenious device, in changing the dials each day they are automatically always synchronized with the clock.



Figs. 1 and 2.—The New National Autograph Time Recorder.

It is claimed that by the use of this recorder it is absolutely necessary that the employee should make his record regularly at stated intervals, otherwise that portion of the dial where the record should have been made will have passed on under the glass without the record, showing the employee to have been negligent, and that he has not attended to his duty. The records show the exact time each dynamo was started and cut out, and the length of time each has been running; also the amperes, from which the average, or total day or night load, or both, can be ascertained. The recorder can be fastened on the wall or laid on a desk, as preferred, as the clock has a marine movement and will run and keep accurate time in either position.

The recorder can of course, as easily be adapted to many other kinds of business where a half-hourly or hourly record is desired; the only change necessary being in the printing of the dials.

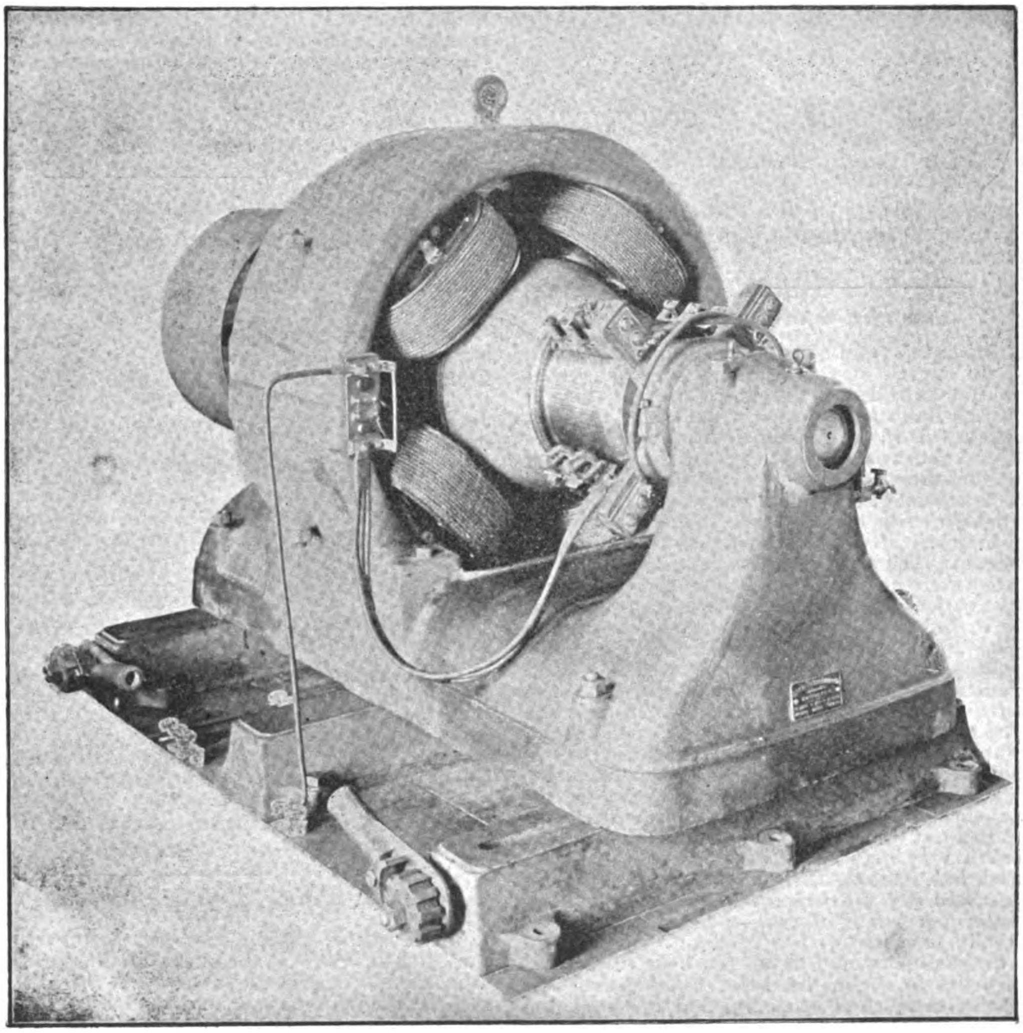
THE PACKARD ELECTRIC CO., LTD., OF MONTREAL, CANADA.

Messrs. W. D. Packard, Jno. H. Howry, Chas. C. Paige, Alex. Mackenzie, Thos. C. Sims, J. W. Packard, H. K. Howry and F. E. Cavanaugh, the first five of whom are to be the first directors, are applying for incorporation as the "Packard Electric Co., Ltd.," with a capital stock of $300,000. The chief place of business will be at Montreal. The company intends to manufacture electrical and other machinery, incandescent lamps, etc.

The Manhattan General Construction Company, of 50 Broadway, New York, have issued a circular calling attention to the fact that they have become the agents for the Fleming woven wire gauze dynamo brush, a description of which appeared in The Electrical Engineer, of Feb. 7.

THE SHAWHAN MULTIPOLAR GENERATOR.

The Shawhan multipolar generator, built by the Shawhan-Thresher Electric Co., Dayton, Onio, embodies many excellent points in its design. The machine illustrated here shows it as it is running in the power house of the Dayton & Soldiers' Home Railway Co., Dayton, Ohio. The armature is of the tooth type, the coils being wound separately and each coil insulated in the most approved manner, thus reducing to a minimum the danger of short circuits. The commutator bars are thoroughly insulated with mica, and are set on a compression frame, with the ends securely bolted in position, which renders it very strong and compact. The brush holders are so designed as to automatically compensate for the wear of the brushes and maintain a positive and even pressure upon the commutator. The field coils are wound upon spools, thoroughly insulated and are then slipped over the pole pieces and held in position by a special clamp. All magnetic parts of the field are of steel, the lower half being cast separate from the base, to which it is carefully fitted and securely bolted in position. The bearings are self-aligning and self-oiling, supported in journal boxes cast in one piece with the base and have large oil chambers for the lubrication of the bearings. The centre of gravity is very low, and its strong and rigid construction renders the machine free from all vibration. This machine has a capacity of 40 kilowatts, wound for 500 volts, with a speed of 600 revolutions, and is compounded to increase the pressure 5 per cent. at full load. In delivering 80 amperes, the electromotive force is 525 volts. It has been in operation the last four months, sixteen hours a day, and has given excellent satisfaction. The Shawhan-Thresher Electric Co. are prepared to furnish this type of generator from 40 to 300 kilowatts, either belted or direct connected, for electric light, railway or power transmission, and in connection with their iron clad motors, described by us some time ago, makes a most efficient equipment.



The Shawhan Multipolar Generator.

St. Lawrence, N. Y.—A bill has been signed incorporating the St. Lawrence Electric Town Site Co., to build a town in St. Lawrence county, on a capital of $3,000,000.

C. J. FIELD, CONSULTING ENGINEER.

Mr. C. J. Field and the Field Engineering Company, with which company the former has been identified since its organization, as President and Chief Engineer, are making a number of changes in their business. The company have been identified, as engineers and contractors, with some of the largest electric railway and central station construction work, and have also been associated as engineers with several of the large syndicates.

Mr. Field and Messrs. Bourne and Cook, who have been connected with him in the management of the company, have determined, owing to the large demand for such services, to devote their time entirely to consulting and supervising engineering work, and to discontinue their interests in construction work. They are, therefore, arranging to gradually wind up the business of The Field Engineering Company, and to continue the engineering and consulting business under the name of C. J. Field, Consulting Engineer. They will continue to do business in the same offices and location in the Central Building, 143 Liberty St., New York, where they have been located for the past four years. They are at present acting in their new capacity for several large roads and banking interests.

A NEW TELEPHONE COMPANY IN NEW YORK CITY.

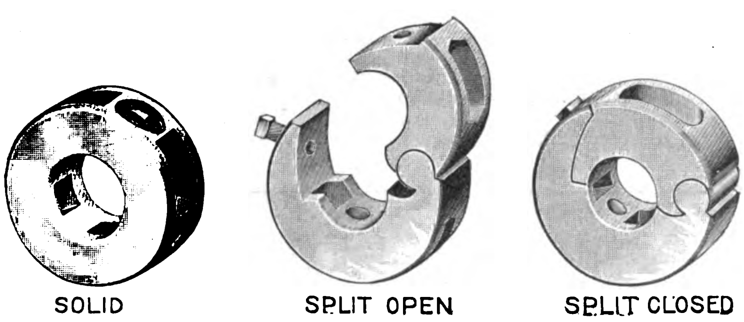
Articles of incorporation were filed recently by the Mercantile Electric Company. The purpose of the organization is to build and maintain telephone and telegraph lines in New York City. Their central station is to be at No. 120 Bradway. Lines are to run from there to the Battery, through Pine street to Nassau, to William street, through Nassau to Broad street to the East River, through William street to Hanover Square, through Wall street to Pearl street, through Pearl to Cedar, through Cedar to Broadway.

The directors of the company are: Henry A. Hurlbut, Lyman Rhodes, Henry S. Terbell, George W. Phillips, Louis Fitzgerald, Thomas D. Jordan and William Giblin. It is denied by Lyman Rhodes that it is the intention to enter the field as a competitor of the Metropolitan Telephone and Telegraph Company. He asserts that it will do a small special business only.

"GIANT" SAFETY COLLARS.

The accompanying illustrations show two forms of the "Giant" safety collar manufactured by the Gouverneur Machine Co., of Governeur, N. Y. As will be seen, these collars are made both solid and split. They are chambered to avoid unnecessary weight upon the shaft, but in such manner as to preserve full bearing surfaces at each end.

The split collar has a hinge joint and may be put upon the shaft in a space equal to its length, and, when in place, the set screw that holds it together also secures it in position on the shaft. No bolts are used, and set screw heads do not project above the surface. Both forms are attractive in appearance and contain material sufficient to give necessary strength where required, useless weight being avoided.


SOLID SPLIT OPEN SPLIT CLOSED

"Giant" Safety Collars.

TESTS OF BABCOCK & WILCOX BOILERS.

The delivery of dry steam from boilers is an essential point in the economy of steam engine operation and as such the recent test of Babcock & Wilcox boilers in the East Cambridge power station of the West End Railway of Boston will prove of interest. The tests are printed in full in the *Boston Journal of Commerce* of May 19, which journal draws special attention to a statement which will surprise engineers familiar with the performances of the Babcock & Wilcox boiler, that upon one test an average of 44.87 per cent. of moisture was found in the steam in a 16 hour run, although the majority of the other tests showed very little moisture in the steam. The tests bear the name of Mr. E. D. Leavitt, although they were not conducted by him personally, but by one of his assistants. Such an unprecedentedly large percentage of moisture can be looked upon only as evidence of error in the use of the calorimeter, for no engineer who will seriously consider what this means will believe these boilers capable of delivering such an immense amount of moisture with the steam, and it is a matter of surprise that Mr. Leavitt should allow such a report to go out over his name without personally verifying such a statement, or at least having the figures bear out his conclusion.

The figures of the report show no evidence of such excessive moisture, but rather point very conclusively to fairly dry steam. The delivery of an excessive amount of moisture with steam always shows itself in a test by seeming to make the evaporation per pound of coal a very high one. But this boiler showed nothing of the kind, but, instead, an ordinary duty; for, if the steam had been assumed dry the evaporation would have been but 8 pounds of water per pound of coal—a small amount. If the steam had really possessed 44 per cent. of moisture the water apparently evaporated would have been over 12 pounds. Upon forcing the boiler to double its rated horse power we naturally look for some sacrifice of economy, and the high flue temperature would indicate this, and an evaporation of 8 pounds under these conditions, as against 9½ pounds shown on the test immediately previous, would certainly offset the high flue temperature. The fact that the apparent evaporation was so small shows clearly that nearly all the water that was sent into the boiler left it as steam with little or no moisture entrained. Nor can it be claimed that the undue forcing of the boiler would account for this moisture, for notwithstanding that 20 per cent. more coal was burned on this test than on February 9, yet the boiler on the latter date is credited in the report with actually absorbing a great deal larger total amount of heat than on the test of February 19, when the largest amount of heat was generated. The limit of heat-absorbing power had not been reached certainly, as the test that followed showed, yet why did the boiler fail to absorb it? The only true conclusion is that the boiler did absorb the heat when the increased amount of heat was generated, and that the moisture allowance is in error and ridiculously excessive.

Accompanying Mr. Leavitt's report the *Journal of Commerce* prints a table showing the performance of Babcock & Wilcox boilers in 39 tests made by well-known steam engineers in which the percentage of moisture in the steam in no case exceeded 2.85 per cent., while the average is less than 1¼ per cent. We may add that a recent test made by Dr. C. E. Emery, Prof. R. H. Thurston, and Mr. J. J. DeKinder on the Babcock & Wilcox boilers in the new Elm street station of the Edison Electric Illuminating Co., in New York, furnishing steam to a 2,500 h. p. Van Vleck engine, showed only 1.1 per cent. of moisture in the steam.

NEW YORK NOTES.

The General Electric Launch Company has just sold an Electric Launch to Cornelius Vanderbilt, for use at Newport. It will be equipped with the Consolidated Electric Storage Company's batteries.

The Abendroth & Root Manufacturing Company, 28 Cliff street, New York city, has issued for gratuitous distribution some finely illustrated trade literature presenting a fund of facts regarding water tube boilers in general and the improved Root water tube boiler in particular. The Company's "Information Pamphlet, No. 8," will be found interesting to all users of steam power.

The Interior Conduit & Insulation Co., 44 Broad street, have issued from the deservedly popular Bartlett Press a very artistic spring catalogue of their Lundell dynamos and motors, now so largely used here and abroad. The catalogue includes all the 1894 styles, not overlooking the fan outfits for which last year they were utterly unable to fill orders, and which this year are better and cheaper than ever. A full list is given of the company's agencies here and in foreign countries.

PHILADELPHIA NOTES.

The La Roche Electric Works are increasing their power plant by the addition of a new 300 h. p. engine. The demand for their well-known alternator and power generator has made this change necessary.

Mr. F. W. Darlington, Ph.B., has opened offices recently at 508 Girard Building. His long connection with the Westinghouse Electric Co. is well known; he is said to have been the first electrical engineer they had. Mr. Darlington also spent 18 months in Japan practising his profession. He is at present chief engineer to the Philadelphia Traction Co., but is also engaged in general work as a consulting and electrical engineer.

W. H. Weston & Co., have found it necessary to move from 830 Filbert St. to much more commodious quarters at 1309 Buttonwood St., owing to the growing demand for their celebrated switches and switchboards. They are at present specially busy on orders for their new style 25, 60 and 150 ampere knife-edge switches. They have recently completed elaborate switchboards for the Temple College, Hotel Hanover, *Enquirer*, and several for the Pennsylvania Railroad Co.

Mr. Harold Binney.—For the convenience of his practice in Philadelphia and vicinity, Mr. Harold Binney of 38 Park Row, New York, has arranged to be at the law offices of Lincoln L. Eyre, Esq., in the "City Trust Building," 927 Chestnut street, Philadelphia, Pa., on the first and third Mondays of each month, for consultation and to attend to all matters arising under the laws of patents, designs, copyrights, and trade marks, remaining in each instance as long as occasion may require and his other engagements permit.

NEW ENGLAND NOTES.

The Perkins Electric Switch Manufacturing Co., of Hartford, Conn., which now controls the manufacture and sale of the Waterhouse-Gamble arc lamp, have, through their Boston office recently secured an order for 125 of these lamps for the new Boston and Maine depot on Causeway street, Boston. The lamps will be used on incandescent circuits, and are for lighting the very extensive train sheds. They were accepted after more than a month's trial of almost all similar lamps on the market.

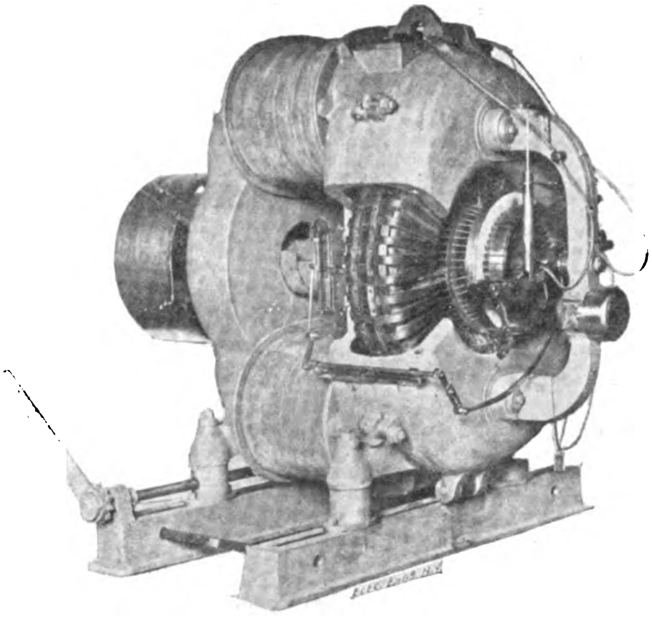
Mr. Henry F. Kellogg general selling agent for the Whitney Electrical Instrument Co., of Penacook, N. H., has just started off on a five months' trip to the Pacific Coast. Mr. Kellogg's friends will probably first see him in Chicago, from which point he will work through almost every state and territory in the country before returning East. Mr. Kellogg reports the demand for the Whitney instruments as excellent, and the factory has recently been forced to work nights to catch up with the orders.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.
Vol. XVII. MAY 30, 1894. No. 317.

THE EXCELSIOR 200-ARC LIGHT MACHINE.

INCANDESCENT lighting and electric power transmission have so absorbed the attention of electrical engineers during the past few years that arc lighting seems to have made but little progress, but a closer examination of the apparatus now available compared with that of only five years back will show that substantial progress has been made both in lamps and in dynamos. As one of the very earliest to enter the field of arc lighting, Mr. Wm. Hochhausen has always kept in view the enlarging of the scope of arc light machines and early foresaw the demand which would arise for machines capable of taking care of the largest number of lamps that could safely be placed on one circuit without coupling together several machines in series. It requires no great amount of calculation to show that the cost of attendance, care and repairs of a number of machines to do a certain work must necessarily be greater than that of a single machine capable of doing the same work, and this is especially the case in arc light generators which probably more than any other type of electrical machinery require the strictest supervision and maintenance.


THE EXCELSIOR 200-ARC LIGHT MACHINE.

Bearing this in mind The Excelsior Electric Co., early in 1890 bought out the Hochhausen 100 light 2,000 c. p. machine which exceeded in capacity by over 35 per cent. any arc machine which had been constructed up to that time. This machine deservedly attracted considerable attention and indeed may be said to have created somewhat of a revolution in arc lighting practice. Its evident economy in operation was so apparent that arc light station managers at once gave it a cordial welcome; but the success of 100 arc machines only served to spur Mr. Hochhausen on to further efforts in the same direction, and the experience gained has now resulted in the construction of a machine capable of feeding no less than 200 2,000 c. p. arc lamps.

This machine, illustrated in the accompanying engraving is constructed on essentially the same lines as the 100 lighter of four years ago, special precautions of course being observed to insulate the potential which in the present instance rises to 10,000 volts at full load. The pole pieces are hinged so that they can be swung back and leave the armature and commutator free for inspection. The machine has but one bearing, on the interior. The regulation is affected by the standard Hochhausen method, namely by a small auxiliary motor placed in the hublike enlargement of the yokes joining the pole pieces. This little motor, controlled by a wall controller, operates to shift the brushes to the proper point with a change of load and by means of a set of lever arms simultaneously varies a set of resistance coils which assist in the regulation.

The following data of this new machine will be of interest :

E. M. F.	10,000 volts.
Current	10 amperes
Speed	625 rev. per min.
Armature.	
Number of coils	48
Size of wire	No. 14 B. & S. G.
No. of turns in each coil	220
No. of commutator segments	48
Diameter of ring, external	33 inches.
" " " internal	20 "
Cross-section of ring	6½ x 6½ "
Field Magnets.	
Size of wire	No. 8 B. & S. G.
Weight of magnet wire	1,600 lbs.
Weight of machine, complete	16,000 "

During a recent visit to the works of the Excelsior Electric Co. we had occasion to witness some extraordinary tests of this new 200-lighter. Arc lamps to the number of 165 (all that happened to be available at the time) each taking 50 volts were connected to the machine, and the whole repeatedly switched on and off without causing the slightest interruption in the operation of the machine. The flashing which takes place under such extreme conditions is by no means abnormal, and as the machine regulates from full to no load in less than two seconds, the effect on the commutator is imperceptible. In the machine in question, which had undergone the violent treatment above described dozens of times, no traces of burning could be seen on the commutator. Such a performance speaks volumes for the regulation and insulation of the new Hochhausen machine.

COMPARATIVE EXPERIMENTS ON THE E. M. F. OF THE CLARK STANDARD CELL.

Mr. K. Kahl details in the *Ann. Phys. Chem.* experiments made with the object of ascertaining the effects which change of form, purity of material, age, and temperature have on the E. M. F. of the Clark standard cell. The H-form devised by Lord Rayleigh, the form proposed by Feussner, and that adopted by the Board of Trade were compared with one another. The results show that the H-cell is far superior to the other two, both in the ease with which it can at any time be reproduced of constant E. M. F. and in the fact that impurities and disturbing influences have less effect on its constancy, so that the variation of its E. M. F. from the normal value can with little difficulty be reduced to 0.0001 volt.

ON THE CONDITIONS OF ECONOMY IN LONG DISTANCE TRANSMISSION OF POWER BY ELECTRICITY.

BY W. A. ANTHONY.

THERE is at present no more inviting or more important field for the work of the electrical engineer than that which pertains to the long distance transmission of power, and there is probably no field of labor which will for the next few years yield a larger return.

The question of the distance to which power can be economically transmitted is of course an all important one, but it is one that can now only be answered tentatively. Next year, or, perhaps, next month, with added experience and new light, we might give an entirely different answer from what we should give to-day. The question may be considered as depending upon three items, the cost of power delivered to the generator, the cost of generators and motors, and the pressure which can be safely cared for on the lines. A fourth item, cost of attendance, will, of course, enter into the result, but this item is one upon which probably there is less ground for discussion than upon the others.

I am glad to see in THE ELECTRICAL ENGINEER, of May 2, a very full and clear discussion of the possibilities of the transmission from Niagara by Messrs. Houston and Kennelly. It is interesting to see that upon the assumptions they have made power may be economically transmitted at least 200 miles. The only question is whether the prices, voltages, and estimates they have assumed, are such as engineers, in the light of experience up to the present, would be willing to accept as a basis of a plan involving large investments. For *long* distances the most important question is one of safe pressure, and upon that I desire to submit a few considerations. In the article referred to the pressure assumed is 50,000 volts (maximum between wires) at the *receiving* station, the pressure at the generating station being left to take care of itself.

It seems to me this is not quite the way to approach the question. Since the pressure to be assumed depends entirely upon our ability to take care of it on the lines the limit should be set at the generating station where the pressure is highest. In Houston and Kennelly's Albany problem for instance, assuming 50,000 volts for the motor station, involves the use of more than 90,000 volts at the generating station. If 90,000 volts is practicable and good for Albany, why is it not good for Syracuse and Buffalo as well? Unless I have misunderstood the reports of the Lauffen-Frankfort experiment, the highest pressure there used was 30,000 volts (about 42,000 maximum) between wires at the *generating* station. Was the experience there sufficiently comprehensive and prolonged to warrant us in assuming as safe more than double the pressure there employed? It seems to me that we need a much more extended experience as to the amount of leakage under various atmospheric conditions, as to the permanence of insulating devices under high pressures long continued, before we are warranted in assuming that even 50,000 volts can be successfully handled. Very possibly we may be able sometime to take care of 100,000, 200,000, even 500,000 volts, but in answering the question as to the distance of economical transmission to-day, we must answer it by reference to knowledge and experience already reached.

As I have said, whatever limit of pressure is assumed should be assumed for the generating station where the pressure is highest since the limit depends entirely upon conditions existing on the line, and not at all upon the generators or motors.

With this assumption the determination of the most economical size of conductors becomes an entirely different problem from that solved by Lord Kelvin which gave us Kelvin's law that the most economical amount of copper for the line is such that the expense for interest and depreciation should equal the cost of energy consumed in the line. Lord Kelvin had in view receivers like incandescent lamps requiring a fixed pressure, and rightly assumed that the pressure at the generator could be raised to make up for any loss on the line. The problem which we meet in long distance transmission is entirely different, the pressure not being limited by the receiver but by the line.

The cost of conveying energy over a line may be conveniently taken as made up of three items, A, the cost of the energy consumed in the conveying; B, expense for interest, repairs and depreciation of conductors; C, expense for interest, etc., of the structure supporting the line; the total cost of conveying the energy is then $A + B + C$.

Since the plan and cost of the structure may be settled upon from a very rough estimate of the amount of copper required for conductors, C may be taken as a fixed quantity and the problem then becomes, to determine the amount of copper in the line which will render the sum $A + B$ a minimum. I shall assume that the expense of interest, repairs and depreciation—the total expense chargeable to the conductors—is proportional to the weights of copper and may be represented by that weight multiplied by a constant.

Let C = the current on the line.
V = pressure at generating station.
w = weight of copper per mile of conductor.
r = resistance of one pound of conductor one mile in length.
s = cost of energy per watt-year delivered to line.
t = interest, etc., on one pound of conductor.
$\frac{r}{w}$ = resistance of one mile of conductor.

(1.) $C^2 \frac{r}{w} s + w t$ = total cost due to conductors of conveying energy over one mile of line. Assuming the cost due to structure as fixed, the above expression represents the whole of the cost that will vary with the weight of copper. This is to be made a minimum. If the pressure at the receiver is fixed, C becomes a fixed quantity, w is the only variable, and the problem is that solved by Lord Kelvin. If the pressure at the generating station is fixed, C varies with w and both vary with the length of the line. The problem in this form was first solved, I think, by Prof. Ayrton some eight or ten years ago.

Let P = power to be delivered to the receiver in watts.
d = distance in miles from generating to receiving station.
$C \frac{r}{w} d$ = "drop" on line.

Then as a first approximation, leaving out of account the power factor,

$$P = C\left(V - C \frac{r}{w} d\right). \qquad (2.)$$

This gives the relation between C and w. From (2.)

$$w = \frac{C^2 r d}{V C - P}. \qquad (3.)$$

Substituting this value of w in (1) we have

(4) $\frac{s(C V - P)}{d} + \frac{C^2 r d t}{C V - P}$ = cost due to conductors of conveying energy P over the distance d.

Solving for C under the condition that makes this cost a minimum,

$$C^2 - 2 \frac{P}{V} C + \frac{s P^2}{s V^2 + r d^2 t} = 0.$$

$$C = \frac{P}{V}\left(1 \pm \sqrt{\frac{r d^2 t}{s V^2 + r d^2 t}}\right). \qquad (5)$$

Since C must be greater than $\frac{P}{V}$ the + sign only can be used.

Let it be required to determine what current and weight of copper would be necessary to convey to Albany from Niagara sufficient power to develop one kilowatt at the motor shaft. Assuming the same efficiency as in Houston and Kennelly's article,

P = 1064. watts.
V = 20,410 volts on each conductor on a basis of 50,000 volts maximum between conductors.
d = 330 miles.
r = 873.7 ohms.
t = .0125, 10% of cost of one pound of copper.
s = .00665.

The value of s is obtained in this way: One K. W. delivered to line requires 1.064 K. W. at turbine, costing $4.25. A rough computation, shows that to deliver one K. W. at Albany will require about 1¾ K. W. delivered to line. A 1¾ K. W. generator would cost upon Houston and Kennelly's estimates about $24, interest on which will add $2.40 to the cost of one K. W. delivered to line. Substituting these values in (5) we have

$$C = .0796.$$

The apparent pressure required to produce the power P is $\frac{1064}{.0796}$ = 13,367 volts. This is the quantity $V - C \frac{r}{w} d$ of (2).

Hence the apparent drop on the line is 7,043 volts. But with a power factor of .9 a pressure of 14,852 volts will be required to develop the power P by the same current. This would require an initial pressure at the generating station of 21,410 volts. But V is only 20,410 volts. Hence the pressures found above must be reduced in the ratio 2041 : 2141 giving the following:

Pressure carrying the current over the line	6,712	volts
and the working pressure	14,154	"
The current required is, therefore	.0556	ampere
and the current on each conductor	.02784	"
The resistance of each conductor is, therefore	241,150	ohms
and the copper per mile in each conductor	1.196	lb.
Total copper in line	1184.	lbs.
Cost of copper at $0.125	$148.00	
Energy lost in line in K. W.	.560	
Cost of energy lost at $6.50 per K. W.	$3.64	
Interest, etc., on copper	$14.80	

This shows that about four-fifths of the expense of conveying the energy to Albany is due to the cost of the line, and one-fifth to the energy lost.

Taking Houston and Kennelly's estimates of cost of machinery, line structure, etc., we have for the investment:

Generator	$22.96
Copper in lines	148.00
Motor	14.95
Line structure	22.00
	$207.91

Interest, etc	$20.72
Cost of 1.727 K. W. at turbines at $4	6.91
Labor, etc	2.68
Total annual cost of delivery of one K. W	$30.31
Or, if on the average only 60 per cent. of this power is delivered the cost is	$50.38

It appears, therefore that at an initial pressure of 50,000 volts, power cannot be delivered in Albany from Niagara to compete with steam, unless the machinery can be operated continuously at its full capacity.

Solving (2) for C we have

$$C = \frac{1}{2} \frac{V w}{r d} \pm \frac{1}{r d} \sqrt{w (V^2 w - 4 P r d)}.$$

The root of the quantity under the radical becomes imaginary when $4 P r d$. is greater than $V^2 w$. This shows that the power P cannot be transmitted to the distance d at all, unless $V^2 w$ is at least equal to $4 P r d$.

Putting these equal and solving for w, using the data assumed for the Albany transmission we have

$$w = \frac{4 P r d}{V^2} = .982.$$

This result would be somewhat changed by the power factor but it may be stated as substantially true, that, with an initial pressure of 50,000 volts maximum between wires of a three phase system, one kilowatt cannot be delivered at a distance of 330 miles over conductors of less size than about one pound per mile each. Of course this limiting value of w occurs when half the power is consumed on the line.

It is seen from the values obtained for minimum cost of delivery that a small increase of the weight of copper over the limiting value reduces very considerably the waste of power.

MEANS OF ELECTRICAL TRANSMISSION FROM NIAGARA WATER POWER.

BY W. L. R. EMMET.

In Messrs. Houston and Kennelly's paper in THE ELECTRICAL ENGINEER of May 2, the possibility of delivery of electrical power directly to distributing systems in the towns supplied without the intervention of motors and generators has not been considered; and since, in very long transmissions such direct distribution would in most cases be inexpedient, the distance limits of economic transmission are probably not affected by this condition. It would seem, however, that in cases like the transmission to Buffalo and Rochester and even to more distant points, it might be practical and expedient to use such a system and to effect such adjustments of pressure at the generator that the power would be available for use without regeneration.

If electric power is received in such a form that it can be delivered to systems of conductors for lighting and power distribution without the use of intermediate generators, its value is materially enhanced, since saving is effected in first cost in power, and in expense of maintenance. The electric light station in its familiar sense is done away with and in its place we have a transformer station containing nothing but stationary transformers and the simple devices required to adjust pressures. In such a station one man can handle and control an almost unlimited amount of power. The space occupied is small and no specially constructed building is necessary.

The only difficult problem in connection with such direct use of power is the maintenance of a constant or uniformly varying electrical pressure at the receiving end of the line. Since in the case considered we would be dealing with the product of one or two generators only, there should be no difficulty in effecting the desired adjustments by a combination of automatic and hand control. The pressures would always be subject to further adjustment in the transformer stations.

In order that electrical power may be directly distributed in this manner with convenience and economy it must fulfill the following requirements: First, its frequency must be such as to adapt it to use with incandescent lamps of the highest practicable voltage and economy. It must also be such as to give the best possible results with arc lamps, which should be regarded as an important factor in all modern electric distribution. Second, the electromotive force must not be subject to sudden or irregular changes. Third, it must be received in such form that it can be conveniently delivered to secondary mains arranged on such a system that they are adapted to the distribution of light and power with good regulation and at a minimum cost of copper without undue complication. Unless such secondary mains are used no distribution of incandescent light by alternating currents can give good results, since there will be uncontrollable variations caused by the variations of load on transformers.

A system of local distribution must be such that only one complete set of conductors is necessary for the delivery of all kinds of service (except possibly large power units which can be operated by special high tension feeders).

The plan which has been actually adopted by the Cataract Construction Co. for the distribution of power from Niagara Falls is very far from filling the requirements enumerated above. The frequency, 25 cycles per second, is far too low for high voltage incandescent lamps, is useless for arc lamps, and entails useless expense and loss in transformers. The two-phase system which has been adopted is entirely impractical for distribution of light and power by means of secondary mains, the cost of copper being prohibitory. Assuming any given maximum lamp voltage the copper required in a two-phase four wire main will be three times that required in a three-phase main having a neutral fourth wire equal in size to the other conductors.

Thus the system adopted is simply a power system, and where it is to be used for general distribution it must simply operate synchronous motors which in turn operate generators which are adapted to the service required. The synchronous motors possess the great merit that they will probably run with great constancy of speed and will give better results in this respect than are attainable with engines. If instead of the system adopted a three-phase system with a frequency of 60 cycles were used and suitable means were employed for maintaining a constant potential the product could be delivered to the consumer at a considerably less cost, and the total investment necessary would be greatly reduced.

ESTIMATE OF THE DISTANCE TO WHICH NIAGARA WATER POWER CAN BE ECONOMICALLY TRANSMITTED BY ELECTRICITY.

BY EDWIN J. HOUSTON, PH.D., AND A. E. KENNELLY, F.R.A.S.

WE have noted with interest the modifications of the prices and conditions which Dr. Emery in his able article, appearing in the issue of THE ELECTRICAL ENGINEER for May 23, considers necessary in order to meet the probable conditions of the case in his judgment.

We note with considerable surprise Dr. Emery's statement that "in very large plants steam engines can be operated somewhat more economically than the 500 H. P. units in the writer's paper, as was indeed suggested by Prof. Forbes in discussing the paper." We regret that Dr. Emery has not explained his reasons for departing so markedly from the opinion he expressed during the discussion of his paper, as it appears in the *Transactions* of the of the American Institute of Electrical Engineers for March 21, 1893, Vol. X, p. 158.

> "The next question is, whether or not 500 horse-power is a sufficiently large unit for general consideration. Prof. Forbes did not use the term unit, but I think that will express his meaning. I used 500 horse-power as being more generally applicable than a larger unit. It is in fact much larger than the average, but sufficiently large to secure maximum performance in the engine. The results would not be materially changed if we were to consider larger plants as multiples of a 500 horse-power plant. The cost of firemen would not change at all, and although one engineer on watch might care for an engine of more than 500 horse-power in a large plant, a chief engineer would also be employed at a higher salary, so that the labor account would not be greatly modified. The table is therefore about right for any large plant."

And again, on page 159:

> "Recurring to the original question I do not think that the operating expenses of a steam plant of 2,500 horse-power, or containing several units of that size would vary from one of 500 horse-power, or made up of several units of that size, sufficiently to predict in advance which would have the advantage. As already stated, one engineer on watch would take care of more horse-power in large units, but the number of men required to do the overhauling on the spare engine, and the salary of a chief engineer or general superintendent, would balance or more than balance the apparent saving for attention. For electric lighting work, the principal saving due to the use of 2,500 horse-power or other large units, would be in the cost of real estate and buildings. In New York City, for instance, the area is limited, land is high-priced, and the larger units take less floor space, so that considerably more engine power can be crowded into the same space, and this may make considerable saving in first cost."

It is true that Dr. Emery has taken in his estimate upon the cost of steam power as published in the *Transactions* of the American Institute of Electrical Engineers before referred to, and as Dr. Emery here mentions, a higher rate of interest, depreciation, etc., upon the capital expended, than that we allowed in our estimates for Niagara; but considering the very stable character of the engineering work already executed at Niagara, and the high character of the engineering talent brought to bear upon it, we think we were justified in rating interest and depreciation at 10 per cent.; and moreover, we did not feel at liberty to change the figures in Dr. Emery's tabulation of the results, to correspond to our estimate for fixed charges upon the capital for this particular case.

We are surprised that so able an engineer as Dr. Emery should rate the efficiency of a 5,000 H. P. generator as low as 90 per cent. We think that even the figure we estimated; namely, 0.96 was unjustifiably low, but we took it in order to be conservative and as we showed, an efficiency in transformers of 0.98 would reduce the efficiency of the generating plant to 0.96 x 0.98 = 0.94. Professor Forbes in his paper says: "There can be little doubt that the efficiency of our dynamos may reach at least 98 per cent." The official report of the Frankfort-Lauffen plant states that the efficiency of the alternator was 95.4 per cent., and this was a dynamo of only about one-twentieth the capacity of those to be installed at Niagara.

If a 5,000 H. P. generator, which has hardly any friction because its weight is borne by the turbine, were to have only an efficiency of 0.9 it would consequently generate 500 H. P. of heat within its own substance.

But allowing 40,000 watts for field excitation, 333,000 watts would be lost in the armature. The total surface of the armature of one of these 5,000 H. P. machines, judging from the designs described by Professor Forbes in his paper, might be approximately 30,000 sq. inches, making the loss of heat per sq. in. 11 watts. This would probably result in a temperature for the armature approaching red heat, the usual safe allowance being 1 watt per sq. in. of armature surfaces. It is out of the question to suppose that any successful 5,000 H. P. generator of the type considered could have so low an efficiency as that Dr. Emery has estimated as being too high.

Again, Dr. Emery considers 0.96 to be a safe efficiency of transformers on average work. This may be a safe figure, but it certainly would not compliment the engineering skill of a manufacturer who would be willing to guarantee no higher figure in large transformers. It is a matter of common knowledge and record from the observations of the best engineers, that 0.96 is the efficiency of good transformers in sizes from 20 to 30 kilowatts at only half load. It is true that the efficiency of transformers of, say, 390 K. W. capacity might fall to 0.96 at low loads, but there is no reason to suppose that any part of the generating plant of the size contemplated, operated by special attendants will ever be operated at less than three-quarters of full load.

We think, therefore, that Dr. Emery's final efficiency of 75 per cent. for the entire generating and motor plant of the character, without allowing any loss in conducting lines, is unnecessarily small, and in entire contradiction to existing plants. Thus the net efficiency of delivering power at Frankfort from Lauffen, including the loss in transmission over conductors to a distance of 109 miles, was, as officially published, 75 per cent. for a plant no larger than 200 horse-power, while the problem under discussion is for a 50,000 K. W. plant in which much greater economony should be expected.

We do not think therefore that the criticisms offered by Dr. Emery call for any modification in our figures.

LABORATORY OF HOUSTON & KENNELLY,
PHILADELPHIA, May 25, 1894.

THE ECONOMIC LIMITS OF NIAGARA POWER TRANSMISSION.

BY FRANCIS B. CROCKER AND CHARLES F. RITTENHOUSE.

It is encouraging to find such favorable figures in regard to the long distance transmission of power as those given by Messrs. Houston & Kennelly in THE ELECTRICAL ENGINEER of May 2, but it is with some hesitation that we can accept their conclusions since some of the assumptions and data are at least questionable.

It would have been more appropriate to have considered the problem on the two-phase basis, since this is the system adopted by the Niagara Company.

Regarding the cost of construction of the hydraulic works, it is interesting to compare their figure of $17.60 per H. P., with that given by Dr. Charles E. Emery,[1] $140 per H. P. Since one estimate is about eight times the other, it shows the great care needed in making comparisons or calculations based upon general data.

We think 10 per cent. two small for the annual interest, depreciation and repairs. At least 5 per cent. should be added for litigation, accidents, interest on unproductive capital and general contingent expenses. The figures given for the cost of generators, motors and transformers, appear remarkably low.

The efficiencies assumed seem too high. Thus their figure of .96 efficiency for the generators or motors and .98 for the transformers might be realized on a test under the best circumstances but are very high for ordinary commercial conditions, and they are certainly not "conservative" as their authors claim. It would also be interesting to know just how 20⅛ lbs. of copper per ampere per mile was arrived at, since on this item alone may rest the correctness of the conclusions drawn, especially with respect to the longer distances. An efficiency in the line of 55 per cent. in the transmission to Albany, which would obtain, according to their figures, appears low, but may be warranted on the basis of their assumptions.

Dr. Emery, in his paper on the cost of steam power, has based his estimates on a 500 H. P. unit and has been far more liberal in the actual cost and interest rates than Messrs. Houston and Kennelly, and it is therefore, hardly fair for them to make a direct comparison between his figures and theirs. For example, Mr. Emery[2] assumes $68. per H. P. as the total cost of the steam plant, which is a far more liberal figure than the price $6.852 per H. P. given by Messrs. Houston and Kennelly as the total purchasing cost of the electric generators "including exciters and all station apparatus."

In short, it does not seem that the cause of long distance power transmission will be helped by assuming the lowest possible costs and expenses and the highest possible efficiencies. It is proverbial that estimates should always be made with ample margin and in nine cases out of ten it is absolutely required.

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[1] *Transact.* Amer. Inst. Elec. Engrs., Vol. X, p. 146.

[2] Ibid. Table I. Col. *l*.

UNIPOLAR DYNAMOS FOR ELECTRIC LIGHT AND POWER.[1]

BY F. B. CROCKER AND C. H. PARMLY.

INTRODUCTION.

THE object of the present paper is to call attention to the fact that unipolar dynamos and motors are much more practical and generally applicable than is ordinarily supposed to be the case. The term unipolar dynamo is here used in its ordinary sense to designate a machine in which electric currents are generated by the *continuous cutting* of lines of force. These machines are identical in principle with the original disc machine of Faraday. The term unipolar is by no means satisfactory, but is almost universally used in connection with machines in which the magnetism in the armature is not reversed by the rotation of the latter. In this broad sense, however, it is also used to include machines of the Mordey and other types in which the lines of force always pass through the armature in the same direction; but in these machines there are separate pole-pieces and the lines of force vary in the armature just the same as in the ordinary bipolar and multipolar types. Moreover, machines of this kind usually have their armatures wound with many turns of wire, they require a commutator in order to generate direct currents, and are radically different in principle from the continuous cutting machines which are the subject of this paper.[2] The term "non-polar" suggested by Forbes is preferable to unipolar, but it is rather meaningless and is liable to be understood to mean any kind of iron-clad machine. Unipolar dynamos are also called *disc* or *tube* machines since the armature is usually made in one or the other of these forms. Neither of these terms, however, covers the other and they are liable to be confused with other types of machine, similar in form but different in principle. The authors suggest *continuous pole* dynamo as a good name for this type of generator.

HISTORICAL NOTES.

The first machine of the unipolar type was Barlow's Wheel described by him in 1823 and consisting of a star shaped disc with long points revolving between the poles of the magnet. A current was passed through the particular portions of the disc between the poles of the magnet and the disc was thereby caused to rotate. This apparatus was therefore the first unipolar motor. Faraday's disc machine constructed and described by him in 1831 was the prototype of the dynamo and was also a unipolar machine.[3] He also made an apparatus working upon the same principle but consisting of a copper cylinder suspended over and revolving around the pole of a bar magnet. This was the first form of tube dynamo.[4] Faraday even at that early time appreciated the difficulty of obtaining a sufficiently high E. M. F. from generators of this type and attempted to accomplish it by having several discs placed side by side and revolving in opposite directions. Similar ideas have been re-invented time after time and even at present it is a favorite field for invention. For many years after Faraday's discoveries the unipolar machine was almost neglected, progress being in the direction of machines having many turns of wire in the armature to obtain a high E. M. F. In 1878 Siemens constructed a unipolar machine with a tube armature of considerable size for actual commercial use in electro-metallurgy. Delafield showed at the Philadelphia Electrical Exhibition of 1884 two unipolar dynamos of the tube type which generated currents of few volts and a large number of amperes. Forbes has also constructed and described unipolar machines, in which the armature is in the form of a cylinder of iron revolving within a field magnet which completely surrounds it. The mechanical and magnetic design of this machine is very ingenious and from the practical standpoint it was a considerable improvement upon anything which preceded it. The highest E. M. F. obtained from these machines appears to have been about 6 volts and nothing further has been heard concerning them for several years. The complete neglect into which this type of dynamo has now fallen is best proved by the fact that no example of them was shown at the Chicago Exposition. In fact it might be said that their present importance is actually *negative* since the only attention which has been given to them lately consists of a few articles on

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[1] A paper read before the American Institute of Electrical Engineers, at Philadelphia, May 16, 1894.

[2] The term unipolar is also applied to the Ball dynamo, but this also acts like an ordinary bipolar machine, except that the magnetic circuit is completed through the air and it is in no sense a "continuous cutting" machine.

[3] Experimental Researches, Vol. 1, Art. 85.

[4] Loc. Cit., Art. 219.

“Unipolar Dynamos which do Not Work” that have appeared in the electrical journals during the past few months.

GENERAL PRINCIPLES.

The action of unipolar dynamos is based upon the fact that a conductor moving in a magnetic field so as to cut lines of force will have an E. M. F. set up in it whether the field be uniform in intensity or variable. The error is very commonly made of supposing that a *variation* in the number or density of the lines of force is necessary in order to produce a current by magneto electric induction. As a matter of fact, however, an E. M. F. must always be produced if any lines of force whatever are cut. It may happen, and in the case of a *coil* of wire, it usually does happen that lines of force are cut in one direction by one portion of the conductor and in the opposite direction by the other portion, in which case one effect neutralizes the other. The simplest example of this is a closed metallic ring moving in a uniform field perpendicular to the lines of force. In this case one half of the ring generates an E. M. F. in one direction and the other half in the opposite direction, so that no *current* is produced; but the full difference of potential corresponding to the number of lines cut per second, will nevertheless exist between the two sides of the ring.

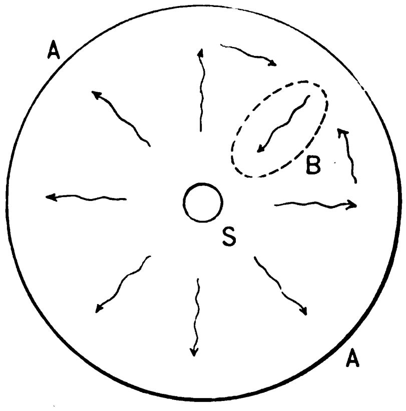

Fig. 1

In the unipolar dynamo or motor a variation in the lines of force is not only unnecessary but is positively objectionable, since it would cause serious losses from eddy currents and hysteresis, whereas if the field is perfectly uniform these losses are practically avoided.

Any break or weakening of the intensity of the field due to “blow holes” in the casting for example would allow the armature current to flow back at that point and would act as a sort of short circuit on the rest of the armature. For example in Fig. 1 let A A represent a disc armature revolving upon a shaft S. The field is of uniform intensity and an equal E. M. F. is generated at each radius, as indicated by the arrows, except that the portion B of the armature is in a weaker field. In this case the current will flow back through the portion B as indicated by the arrow, and the armature will be like a short-circuited one of the ordinary kind. This back current will flow and produce heating and loss of energy even though the external circuit be open.

It is also a common error in regard to unipolar machines to suppose that the armature cannot be made of iron. As a matter of fact iron or steel is usually better than copper because it is a much better conductor of magnetism and the reluctance of the magnetic circuit can be reduced far below what is possible with a copper armature, the only air gaps being the small mechanical clearances required for free rotation. A steel or wrought iron armature is much stronger than one of copper not only on account of its greater strength for the same thickness but also because it can be made much thicker without causing any appreciable increase in the reluctance of the magnetic circuit, whereas a copper armature would have to be made very thin. The greater specific resistance of iron is not objectionable since an armature composed of it would have a current capacity far greater than is required and the thickness can be increased to make up for the higher specific resistance.

METHODS OF MULTIPLYING THE E. M. F.

The plan suggested by Faraday was to have two or more discs side by side revolving in opposite directions, the edges being connected together by mercury or other contacts so that the current flows outward from the centre to the periphery in one disc, inward in the next disc and so on in series. In this way it is possible to multiply the voltage as many times as there are discs; but there are obvious mechanical difficulties in rotating these discs in opposite directions and the numerous electrical contacts would be decidedly objectionable. Hundreds of modifications of this idea have been suggested; for example, Siemens, in the tube machine already referred to, multiplied the E. M F. by splitting the tube longitudinally and placing rings on the end of the tube so that the current was carried first through one section of the tube, then through another, and so on. In this way the circuit may be threaded through the magnetic field a number of times, each time a certain E. M. F. being added. Another plan to accomplish the same result would be to have a number of thin tubes placed concentrically one within the other, but separated by a layer of insulating material and connected so that the current passes first through one tube, is then carried around outside of the machine and is passed through another tube, and so on, through all of them in series.

There is no theoretical limit to multiplying the voltage by some such method, but practically any of these constructions would have very serious, if not fatal, mechanical and electrical difficulties. It would seem to be far preferable to construct the machine of sufficient size and run it at sufficient velocity to get the required voltage without complicating the construction. There is no objection, however, to connecting two unipolar machines in series, both being driven, for example, by one engine, which may be belted or direct coupled, and there is no serious complication involved in operating four or even more machines in series. The first cost and attendance required would probably be much less with four unipolar machines than with one direct current machine of the ordinary type.

One very convenient way to multiply the voltage of a dynamo would be to charge a number of storage batteries by means of a low voltage machine of say 10 or 20 volts. When charged, these batteries could be connected in series to give any desired E. M. F., 115 or 230 volts for example, and the actual working current would be supplied by them. The charging could be done at hours when the current was not required, or two batteries could be used alternately to give an uninterrupted supply of current. In this way two advantages could be realized, first the cheapness and simplicity of the unipolar dynamo, and second, the uniformity of load with which the engine and dynamo could be run.

PRACTICAL DESIGN.

It is not difficult to get up complicated puzzles in connection with peculiar forms of unipolar machines, but in the simple and probably the only practical forms, we have a single straight conductor which cuts all the lines of the magnetic field once per revolution. In the case of the disc machine we can consider any radius of the disc as constituting the conductor and in the case of the tube machine it is any element of the cylinder.

The theory of the magnetic circuit is now well understood, and modern practice in the design of dynamos and motors fully appreciates the advantages which result from making the ratio between the length of the magnetic circuit and its cross-section a minimum. In a unipolar dynamo this reduction of the reluctance of the circuit can be carried farther than in any other class of machines because the creation of an electromotive force by the continuous cutting of the lines of force enables a form of magnetic circuit to be employed which in the highest degree combines the advantages of minimum length with maximum cross-section. This type of magnetic circuit is the circular ring; for if we surround a circular coil D D of wire carrying a current with two circular rings of semi-circular cross-section, as shown in Fig. 2, we shall form a closed magnetic circuit of maximum induction for minimum excitation. Cut this circuit along any radius of the circular cross-section and a magnetic field is obtained

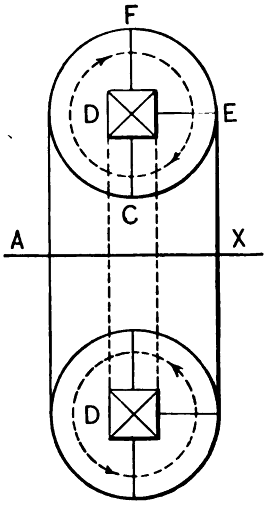

Fig. 2

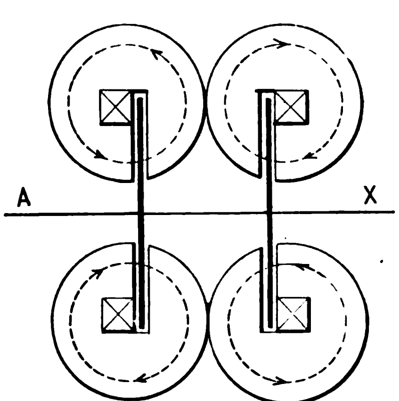

Fig. 3

in which, if an inductor be rotated about A X as an axis, there will result a continuous cutting of the lines of force, which only requires that appropriate collectors be provided to form a closed electrical circuit, in order to produce a current of electricity. The magnetic circuit is indicated by dotted circles with arrow heads.

There are, however, but two directions in which the magnetic circuit can be cut so as to form a field suitable for practical use. One is along the radius C D, in which case the inductor will rotate in a plane perpendicular to the axis, and the other is along the radius E D, in which case the inductor will move in the convex surface of a cylinder whose axis is the axis of rotation. In the first case the armature of the resulting dynamo will be a disc, and in the second case a cylinder. In both, the way to collect the current would be to provide one set of collectors at the centre of the circular cross-section and the other set at the axis, thus utilizing the shaft as a portion of the electrical circuit. The relative advantages and disadvantages of the two forms depend upon circumstances in each particular instance.

In many cases the single magnetic circuit shown in Fig. 2 is not the best for practical use, because it would be necessary to make the diameter of the ring larger than it would be if two rings were placed side by side as shown in Fig. 3 and Fig. 7, because in this type of dynamo we must depend wholly upon the total magnetic induction and the speed of rotation to produce the electromotive force, as it does not appear to be practicable to greatly multiply the voltage by multiplying the number of inductors.

Another consideration of importance is the volume of the ring. It is evident that any required area of pole surface can be provided by keeping the mean diameter of the ring constant and varying the radius of the circular cross-section between certain limits, or by keeping this radius constant and varying the mean diameter of the whole ring. It is also evident that for any particular required area of pole surface any decrease in the mean diameter of the ring requires a corresponding increase in the radius of the circular cross-section and vice versa. In Fig. 4 let the circle whose radius is r and the distance of whose centre from the axis of X is b revolve about that axis, generating a volume of revolution. This volume forms the field magnet and contains nearly all the weight and a large part of the cost of the machine. This volume which is an annulus may be determined by the centrobaric method according to which a volume of revolution is equal to the generating area multiplied by the circumference described by its centre of gravity. Hence the volume

$$V = 2\,\pi^2\,r^2\,b. \tag{1}$$

The factors r and b must have certain values in order to produce the required E. M. F., the latter being usually the definite object for which a dynamo is designed. The values of r and b are found as follows:

Let E = the required electromotive force expressed in volts.
" n = the number of revolutions per minute.
" B = the number of magnetic lines per square inch.
" A = the number of square inches of pole surface.
" r = the radius of the circular cross-section of the ring expressed in inches.

Then because the two rings are wound so that the electromotive force due to the field of one is added to that due to the other, each ring must be designed to provide enough lines to generate only $\frac{E}{2}$ volts. This requires that $\frac{E}{2} \times 10^8$ lines must be cut per second, or $\frac{E}{2} \times 10^8 + \frac{n}{60}$ per revolution. Hence the number of square inches of pole surface needed is

$$A = \frac{30\,E \times 10^8}{n\,B}. \tag{2}$$

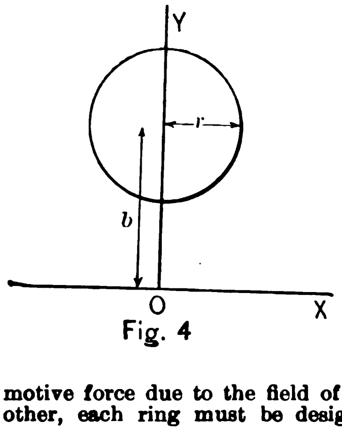

Fig. 4

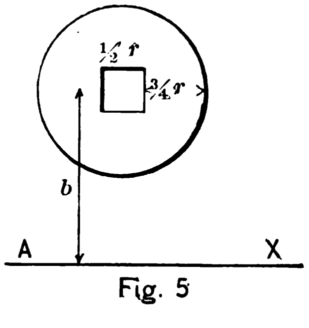

Fig. 5

As shown in Fig. 3, the core of the ring will be utilized for the exciting coil, and for simplicity of construction we shall make its cross-section square. It is desirable to keep the size of this square as small as possible because any increase in the length of a side increases the diameter of the circular cross-section an equal amount and therefore enormously increases the volume which is proportional to the second power of the diameter. But this square cannot in practice be made indefinitely small, because too great a concentration of the lines immediately surrounding the coil must be avoided, and space enough provided to give ample excitation. One half of the radius appears to be a length suitable for the side of this square. Referring to Fig. 5 we shall then have an area of pole surface.

$$A = 2\,\pi\,b\,\tfrac{3}{4}\,r. \tag{3}$$

But we have seen in equation (2) that we need an area equal to $\frac{30\,E \times 10^8}{n\,B}$; hence equating this with the above value of A, we have

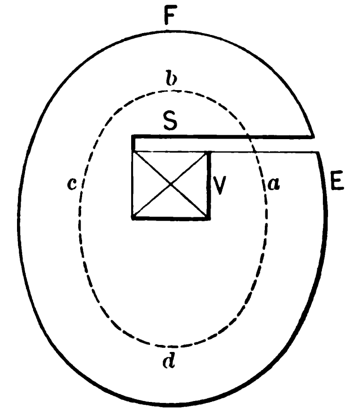

Fig. 6

$$2\,\pi\,b.\ \tfrac{3}{4}\,r = \frac{30\,E \times 10^8}{n\,B}.$$

The ratio between b and r which seems to best fulfill the conditions of good design is $b = 2.5\,r$. Making this substitution above and designing so that $2\,b$ equals the outer diameter D of the armature we have

$$D = 10^5 \sqrt{\frac{2\,E}{\pi\,n\,B}} \tag{4}$$

which shows that the dimensions of the machine are directly proportional to the square root of the required electromotive force, and reciprocally proportional to the square roots of the speed and of the magnetic induction. It is to be further observed that since for machines varying widely in their outputs B is nearly constant, the most important ratio in equation (4) is $\frac{E}{n}$. In the design of a machine for any special voltage, however, E is fixed, and therefore the only arbitrary quantity is n; so that the whole problem is to determine the values of D and n which give the best design.

Let v = the peripheral speed in feet per second; then we have

$$v = \frac{\pi\,n\,D}{720},$$

whence

$$D\,n = \frac{720\,v}{\pi}. \tag{5}$$

Substituting in this equation the value of D given by equation (4) we have

$$n = 0.00000825\,\frac{v^2\ B}{E},$$

and

$$D = \frac{10^6}{36}\ \frac{E}{v\,B}, \tag{7}$$

from which the values of D and n can be immediately determined for any prescribed values of E, B, and v.

The maximum velocity in feet per second which the rim of a fly-wheel may with safety attain is given by the equation[5]

$$v = 3\ \sqrt{t}$$

where t is the safe stress of the metal in pounds per square inch. If the inductor be of wrought iron or of steel for which $t = 10000$, we shall have $v = 300$; and if of cast iron for which $t = 5000$, we shall have $v = 210$ nearly. The much higher permeability of cast steel over cast iron, and its comparatively small additional cost make it the metal most economical to use, and we shall therefore assume that the inductor is either of wrought iron or of cast or

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5. Thurston, "Manual of the Steam Engine," Part II, Art. III, p. 422.

forged steel. Hence making $v = 300$ in equation (5) we find that the maximum value which the product Dn can attain is $Dn = 68750$. This then is a condition which must not be exceeded in order that the design shall be mechanically safe. Making $v = 300$ in equations (6) and (7) we have

$$n = .7425\ \frac{B}{E} \tag{8}$$

and

$$D = \frac{10^7}{108}.\ \frac{E}{B}. \tag{9}$$

If the armature were made of forged steel it would be allowable to assume t to be as high as 20,000 since the armature is entirely enclosed and could do no harm even if it burst. In this case $v = 423$.

We have now to deduce a formula for the number of ampere-turns required to produce the necessary excitation. As a first approximation and to enable us to determine the general conditions the cross-section of the ring was assumed circular. In practice, however, this form of section must be modified, for a reference to Fig. 2 shows that in order to give the same area of cross-section perpendicular to the direction of the lines of force at D C and D F as at D E we must cause the circular cross-section to bulge out on the side toward the axis and contract on the side away from the axis.

On account of the diminution of cross-section due to the air gap and to the holes for the brushes it is found necessary, however, to preserve for the outer portion of the ring a semi-circular cross-section and it ultimately assumes the form shown in Fig. 6.

The mean length of the magnetic circuit is therefore the length of the semi-circle $a\ b\ c$ plus the length of the curve $a\ d\ c$. Assuming the air gap to be $.06\sqrt{D}$ we have the data for determining the ampere-turns required.

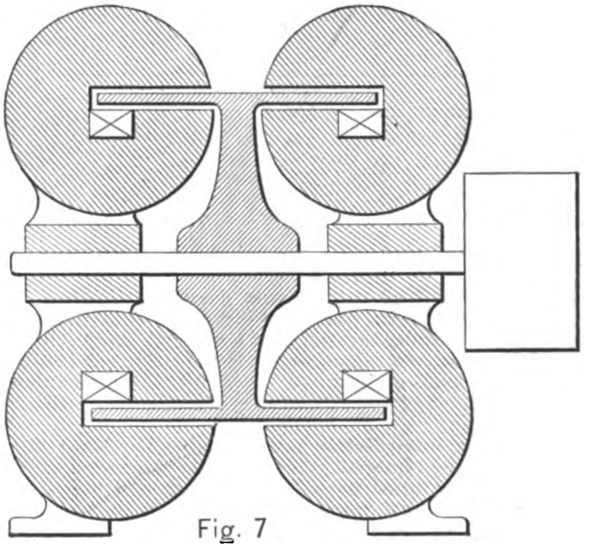

Fig. 7

The amount of current which the dynamo can generate is determined by the carrying capacity of the armature and brushes. Since $.2\sqrt{D}$ may be assumed to be the thickness of the inductor we have for the current carrying cross-section of the armature

$$.2\ \pi\ D^{\frac{3}{2}}$$

square inches. Since iron or steel would carry at least 200 amperes per square inch the current capacity of the armature is

$$C = 40\ \pi\ D^{\frac{3}{2}} \tag{10}$$

which at E volts gives the capacity of the machine in watts

$$W = 40\ \pi\ D^{\frac{3}{2}}\ E. \tag{11}$$

To show the application of these formulæ to two widely different classes of machines, let it be required:

First: To design a belt-connected dynamo to generate 10 volts at 1,200 revolutions per minute for electro-metallurgical purposes. Making field-magnets and armature all of cast steel and taking the induction B at 90,000 lines per square inch we have,

from equation (4) $D = 24.28$ = diameter armature in inches.

Second: To design a direct-connected dynamo to generate 130 volts at 200 revolutions per minute for light and power purposes. As before we have

$$D = 214.4.$$

These figures show the immense possibilities of the unipolar dynamo, possibilities so immense indeed that the practical difficulty is not in the design of the dynamo, but in the design of the steam engine. Two machines like the last coupled at the ends of the shaft of a 100,000 h. p. engine would supply more current than is at present consumed in any two cities in the world. Nor is the excessive current a disadvantage, for while we would point out the tremendous capacity of one of these dynamos, there is no necessity for running them at their maximum output. Even if we diminished the current to one-hundredth its ultimate value and only use a 1,000 h. p. engine to drive the dynamo, the loss due to the resistance of the armature will still be only four or five per cent.

A more economical way of supplying current for light and power, however, would be to design unipolar dynamos of less current carrying capacity and less voltage, and then join in series on the same shaft as many as are needed to produce the required electromotive force. For example, we may generate 130 volts by joining in series on the same belt-driven shaft two dynamos each giving 65 volts at 800 revolutions per minute.

The dimensions will be as follows:—

$$D = 75.81.$$

Running this combination at one-tenth of its ultimate capacity by means of a 1,250 h. p. engine, we should still have a very high efficiency.

Methods of taking off the Current. The best means of making electrical connection with the revolving armature is a very important but somewhat difficult matter. A great many devices have been tried or suggested. The principal of these are brushes of copper gauze or carbon, and mercury contacts applied to the edges of the disc or tube. Belts or straps made of flexible sheet copper or copper wire cable have also been used. One application of this latter device consists in connecting together two armatures by such a belt whereby the E. M. F.'s of the two machines are added together and, if necessary, the mechanical power for driving one or both machines can be transmitted by this same belt. There would not seem to be any great difficulty in applying brushes to a unipolar dynamo; in fact for a given current it would seem to be a much easier problem than with a direct current machine having a commutator since the former has a continuous and smooth bearing surface for the brushes instead of the somewhat uneven surface of copper and mica which exists on a commutator. It is a fact that the speed may be very high but with the perfectly smooth surface and by the use of brushes with light pressure and composed wholly or partly of graphite or some friction metal which might even be lubricated, it would appear to be possible to take off a current sufficient for almost any electric light or power use. If the very high speed makes the friction too great to permit of the use of brushes, the edge of the tube or disc may be arranged to run in a mercury trough, thereby making a good electrical contact with very little friction. In this case however, provision should be made to prevent the mercury from being thrown off by centrifugal force, as by the use of a guard ring extending all round the edge of the tube or disc. Another device would consist of ball bearings applied to the shaft or to the periphery of the disc or cylinder. These might perform their ordinary mechanical function and also serve to take off the current.

Method of Driving.—There are various mechanical arrangements available for connecting a unipolar dynamo to the source of power. The simplest would be to connect the dynamo to the engine by means of ordinary leather belting, either with or without the use of a countershaft. In this way a high speed can easily be obtained if desired and is perfectly permissible since the solid disc or tube of steel which constitutes the armature is capable of a much higher speed of rotation than the ordinary built-up form of armature now used. It would probably be safe to have a solid steel armature run at two to four times the speed of the ordinary armature having the same diameter.

If the dynamo be directly coupled to the engine the speed of the latter and the diameter of the armature may be most economically proportioned to give any desired voltage by the application of the previous equations.

An arrangement which seems to possess great advantages would consist of a steam turbine running at 10,000 or 20,000 revolutions per minute, which is the ordinary speed of such machines, directly coupled to a unipolar dynamo. These two machines seem to be admirably suited to each other, the very high speed of the turbine compensating for the fact that there is but one inductor. This combination entirely avoids the necessity for reducing the speed of the engine by gearing which is done in the case of the Laval turbine, or the risk which is involved in running a wire-wound armature and sectional commutator at a speed of 10,000 or more revolutions per minute which is the plan adopted with the Parsons turbine.

Advantages of unipolar dynamos and motors.—The greatest advantage of the unipolar machine is its extreme simplicity. Its armature consists of nothing but a solid cylinder or disc of steel, or other suitable metal firmly mounted upon a shaft. We have only to compare this construction with that of the ordinary armature consisting of hundreds of pieces of sheet iron, bolted or otherwise held together to form the armature core, and wound with a great many turns of wire or bars of copper which have to be thoroughly insulated from each other and which are not very securely held in place. In addition to this we have the commutator consisting of 50 or more sections of copper separated by strips of mica and held together by nuts, etc. The electrical connections between the armature and commutator also add to the complication. In short it would be difficult to find any two pieces of machinery in which the contrast between simplicity and complication is greater. The construction of the field magnet and the rest of the machine is also very simple. The elimination of the commutator although already mentioned in connection with simplicity is nevertheless an essential feature of this type of machine and is a great advantage. The almost infinitesimal armature resistance of these machines is decidedly advantageous, not only in increasing efficiency and decreasing heating, but also because it causes the machine to regulate more closely either as a dynamo or as a motor. According to all accepted theories there would be no hysteresis in these machines because both the armature and field are always magnetized in exactly the same direction and to exactly the same intensity.[6] For similar reasons there would be no Foucault currents, since the E. M. F. generated in any element of the armature would be exactly equal to that generated in any other element and there could be no tendency to produce eddying currents. This perfect uniformity of the magnetic field is secured by the construction which is exactly symmetrical, the air gap being precisely the same at all points.

The question of armature reaction is somewhat doubtful since some authorities state that it is quite considerable, but in the opinion of the authors it is very small, and certainly no greater than in other types of machine. The armature consists of only a single turn, consequently the maximum magnetizing effect of the armature in ampere-turns is numerically equal to its current capacity, and since the ampere-turns on the field would be made considerably greater than this, the armature reaction cannot be great. It is interesting to consider how armature reaction can occur in such a machine. The probability is that it has the effect of curving and slightly lengthening the lines of force so that they do not pass perpendicularly from one pole surface to the other in the air gap and have a spiral path in the iron since the field current tends to produce lines in planes passing through the axis and the armature current acts at right angles, producing an inclined resultant. There can of course be no change of distribution of magnetism as a result of armature reaction, which is the really objectionable effect that it produces in the present types of machines and in the unipolar machines there are no back ampere turns and no magnetic leakage.

In conclusion we may say that unipolar machines are practically indestructible since, they are so simple and so strong that they are not likely to be damaged mechanically and it is almost impossible to conceive of one being burnt out or otherwise injured electrically, since the engine would be stalled by the enormous current before the armature could be fused by it. A machine possessing all these important advantages certainly deserves a prominent place in electrical engineering, whereas it now has practically no existence whatever.

DISCRIMINATING LIGHTNING ARRESTERS, AND RECENT PROGRESS IN MEANS FOR PROTECTION AGAINST LIGHTNING.—II.

(*Concluded.*)

BY ALEXANDER JAY WURTS.

PART III.—DISCRIMINATING LIGHTNING ARRESTERS.

The Condenser Lightning Arrester.—The discovery and practical application of non-arcing metal to alternating current circuits about two years ago,[1] has indicated the possibility of constructing a discriminating lightning arrester, as it were, for direct current circuits; that is, an arrester which should not require the usual automatic circuit interrupting attachment, but which, by virtue of its material or construction, should allow static electricity to pass and prove an effectual barrier to the dynamo current.

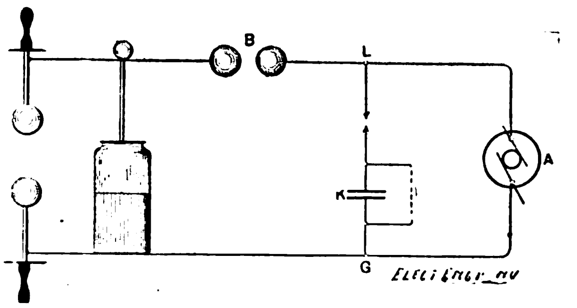

FIG. 4.

The first step taken in this direction was to carefully analyze the conditions, and the general conclusions arrived at were as follows: A circuit becomes charged in various ways with static electricity tending to earth. These charges are, in a majority of cases, small and of no considerable intensity. The surgings in the system find points of reflection which also become points of greatly increased tension. The earth is the great reservoir (to use common language) for these discharges. This reservoir is, however, unnecessarily large for the accommodation of line discharges. Might not smaller reservoirs be made—little earths insulated from the mother earth? If the circuit were connected directly or through spark gaps to such little earths, these dangerous surgings might be broken up and the line safely discharged without a possibility of the dynamo current following. Each spark gap in each of such discharge circuits would then form a discriminating lightning arrester, but these little earths would be nothing more nor less than one coating of a condenser—the mother earth a common coating to them all. Why not then use condensers, connecting one side to line, the other to earth through a spark gap?

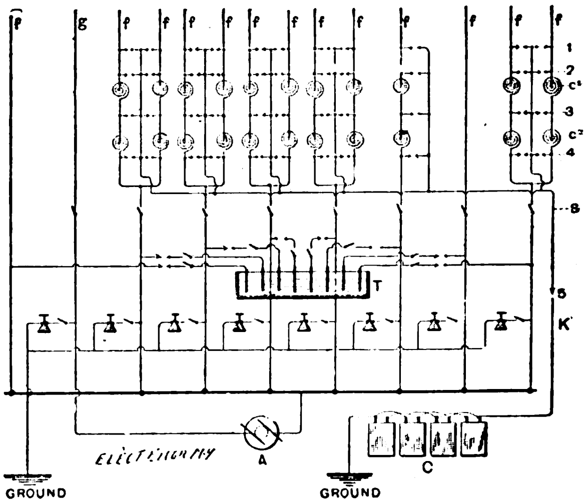

FIG. 5.

One difficulty immediately presented itself. After the condenser had become charged how was it to become discharged? To be successful it must be self-discharging, and not only this, but the discharge must take place in such a manner that no dynamo current should follow. Therefore, to discharge the condenser disruptively was at once out of the question. After various experiments a pencil mark over ground glass was suggested and this was found to work admirably. A medium pencil was rubbed back and forth over a strip of ground glass, making a narrow shining streak having a resistance of from 40,000 to 50,000 ohms. Rubbing with the hands did not seem to appreciably change this resistance. Broad black pencil marks were made on the ends for better contact, and connection to the terminals of the condenser was obtained through aluminum foil, both glass and foil being protected on the bottom by the wooden case of the condenser, and on top by a small inverted wooden trough. A condenser provided with such a pencil mark leak, was now connected to a 500-volt direct current circuit and to apparatus, as shown in Fig. 4. A was a 500-volt direct current generator; L one leg of the circuit, which may represent a trolley wire; G the other leg of the circuit, and which may represent the ground return; K the two M. F. condenser with its high resistance leak *l*; C a small spark gap in series with the condenser, and in the discharge circuit; B was a 12–32 inch spark gap over which disruptive discharges would pass from the battery of Leyden jars (11), and in this manner suddenly charge the line L. The most violent disruptive discharges that could be obtained in the laboratory, were unable to damage either the generator or the condenser. A small spark gap, a trifle larger than C connected either in series or in shunt to the generator, failed to take any of the discharges, thus demonstrating the ease with which the discharges were received by the condenser.

For line or outdoor use the condenser was placed in a suitable cast-iron box, one terminal of the condenser being grounded to it while the other was led out through a specially designed and water-tight bushing. If then this iron box were buried in damp earth, as a ground plate, so to speak, the outer terminal connected to the lower electrode of a small spark gap placed on a pole, and the upper electrode of the gap connected to the line, the combination would constitute a discriminating line lightning arrester.

Practical tests have been made during the past summer with sults obtained have been most gratifying. The plant in which the apparatus was installed was that of the Denver Tramway Company, Denver, Colorado, in a locality where lightning storms are particularly severe and of frequent occurrence.

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[6] There might be some molecular friction due to cutting the lines of force, but this would probably be slight.

[1] Transactions A. I. E. E., vol. ix., p. 102, 1892.

The installation of these condenser lightning arresters consisted of five arresters on the line and 44 spark gaps with 11 condensers in the station. The station spark gaps were also provided with two specially constructed choke coils for each feeder. The original arrangement of this apparatus is shown in Fig. 5. A is the generator; *f f* etc., the feeders, 1, 2, 3, 4, etc. the 44 spark gaps alluded to; C^1 C^2 the two choke coils in series with each feeder; S represents the circuit-breakers and K Keystone lightning arresters; C is a bank of four 2 MF. condensers, making a common ground for the 44 spark gaps; T is a tank lightning arrester; G is an overhead ground return; 5 a spark gap in the ground wire of the 44 spark gaps. A tell-tale piece of tissue paper was placed in this gap, which, becoming punctured, would at once indicate and register the passage of a discharge across any of the 44 spark gaps.

The sensitiveness of these condenser arresters was particularly noticeable, in that the tell-tale papers were found to be punctured at the slightest provocation, when in fact no considerable thunder storm had passed over the lines, and yet, sensitive as they were to slight charges on the line it is remarkable to note that the simple carbon spark gaps belonging to the local company, which have already been mentioned and which provided a gap 1-8 inch between electrodes, frequently received discharges in preference to the minute spark gap of a neighboring condenser line arrester. Such occurrences coupled with many others of a similar nature point to the existence of nodal points, and the necessity of distributing line arresters at frequent intervals over the system.

In fact a lightning arrester connected directly to the terminals of a generator or motor offers no absolute guarantee of protection to this particular piece of apparatus. The presence of the arrester simply offers an opportunity for discharge. The discharge may occur in the armature or it may occur through the arrester, according to the particular conditions existing at the time of each discharge. The arrester could have a comparatively large spark gap, and the breaking down strain of the armature insulation be low and still the discharge might prefer the large gap to the weaker insulation, while on the other hand the arrester could have a very small spark gap and the armature be provided with the highest grade of insulation, yet in some cases this insulation would be pierced by the discharge in preference to the small spark gap of the neighboring arrester.

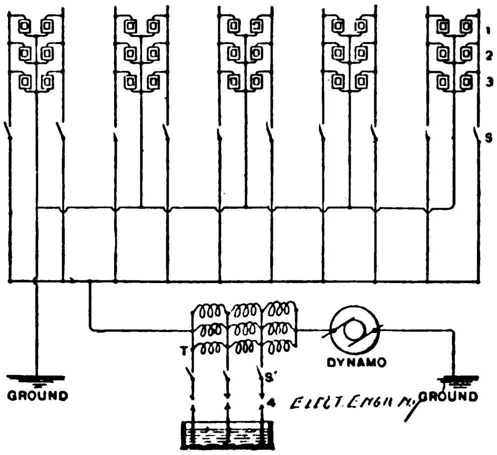

FIG. 6.

The results obtained with these condenser arresters have exceeded my expectations, and in my opinion have thrown considerable light on the intensity and volume of discharges commonly found in electric light and power circuits. During my two months' stay in Denver not a single condenser was disabled, nor were any of the tell-tale papers burned.

I have, however, designed a lightning arrester which is much smaller, cheaper and, perhaps, in every way more desirable than the condenser arrester. It is also a discriminating lightning arrester.

I had frequently noticed what is probably familiar to many of you, namely, that a disruptive discharge will leap over a non-conducting surface much more readily than through an equal air space. The non-conducting surface seems to form an entering wedge, as it were, through the air, so that this being already partly split or ruptured, the discharge has but to further separate the air from the non-conducting surface instead of boring its own path through it. A pencil mark over a rough piece of glass or unpolished marble still further reduces the breaking down strain.

But to avail myself of this fact in the construction of a lightning arrester was a problem over which I pondered for some time. My design was to bring electrodes located in a discharge surface near enough together to form a lightning arrester spark gap, and at the same time to avoid the passage of dynamo current when the electrodes were connected to the terminals of a 500 volt direct current generator. I reasoned that a dynamo arc to be maintained must be fed by the vapors of its electrodes. To prevent an arc, the formation of such vapors must be suppressed. My first attempt in this direction proved successful. I drew a pencil mark about two inches long over an unpolished piece of marble, covered this with a second piece similar to the first, and, having previously slipped between the two marbles, pieces of aluminum foil as terminals to the pencil mark, I bound the whole together with twine. These terminals were now connected to the terminals of the five hundred-volt direct current generator and disruptive discharges caused to pass between the marbles and over the pencil mark. A one-ampere fuse was connected in the dynamo circuit. No current following these discharges, the terminal foils were brought successively nearer together, testing each time for the passage of dynamo current. When the electrodes had reached a distance of a quarter of an inch from each other the fuse was blown. The terminals were now placed a half-inch apart, and oft repeated tests failed to establish a short-circuit. The dynamo was now cut out and upon resting my hand on the upper marble, while the discharges were still passing, I noticed a considerable mechanical shock. and when the twine was removed, the upper block was thrown off. In consequence of this, it seemed advisable to provide more space for the discharge. A small groove was, therefore, cut in the lower marble from one electrode to the other. and well blackened with a lead pencil mark. Discharges now failed to produce the above mentioned mechanical shock, or to throw off the cover. It was, however, noticed, that after several discharges had passed, this pencil mark disappeared, having been dissipated and apparently scattered over the surfaces of the two marbles. To overcome this difficulty a piece of wood was laid into the lower marble between the electrodes, and into this a shallow groove was burned. This construction seems to possess some advantages over the one already described—it suggested more lasting qualities. Various materials were now tested into which one or more discharge grooves might be burned, such as fibre, felt, leather, ivory, boxwood, celluloid and others, but most of these proved unsatisfactory for various reasons. With fibre, the charred surface was quickly worn away, ivory chipped off in small pieces, both leather and felt crumbled away. Lignum vitæ, however, proved to be a most excellent materal. In the final form adopted for this arrester both upper and lower blocks were made of this material, thus enabling the discharged grooves to be burned into the lower block itself, and avoiding the necessity of inserting a discharge piece between the metal electrodes. The blocks are 3 inches wide by 3½ inches long and 1 inch thick. Two brass electrodes each 1 inch wide are laid into the lower block, flush with its surface, the distance between electrodes being ½ inch. The charred grooves are nine in number, and about $\frac{1}{16}$ inch wide by $\frac{1}{32}$ inch deep.

The non-arcing property of the arrester is easily understood; the conducting vapors which are necessary to the formation and maintenance of a dynamo arc are supressed by the cover which fits tightly over the metal electrodes.

A thorough test of these arresters has been made in both Denver and Colorado Springs during the past summer. There were ten feeders, each feeder being provided with three arresters placed three feet apart, Fig. 6.

This non-arcing railway lightning arrester is eminently suited for the protection of direct current circuits up to 1,000 volts. On 1,000-volt alternating current circuits from smooth body armatures it also operates satisfactorily, but on similar circuits from toothed body armatures the arresters break down after a few discharges, and a short-circuit is established. However, it is not impossible that two or three of the arresters might not be used to good advantage in series on circuits of high potential.

The proper number of line arresters, is that number which will prevent discharges from entering the station. Station arresters, if used at all, should be installed with the one idea of providing a final opportunity for discharge, but as the tendency to discharge occurs on the line, often several miles away from the station, a sufficient opportunity should be provided *there* where the tendency to discharge originates, and in this manner advantage may be taken of the large inductive resistance afforded by the circuits leading back to the station. If discharges enter the station it is a sure indication that they have done so for lack of sufficient opportunity to discharge from the line—for lack of a sufficient number of line arresters. It is well to protect dynamos with lightning arresters—it is better to avoid the necessity of this protection by discharging the line. It is even well to use a lightning arrester having a circuit interrupting attachment. It is better to avoid the necessity of a circuit interrupting attachment by using a non-arcing arrester.

both station and line condenser lightning arresters, and the re-

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

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T. COMMERFORD MARTIN AND JOSEPH WETZLER.
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Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum, $3.00
Four or more Copies, in Clubs (each) - - - - - - " 2.50
Great Britain and other Foreign Countries within the Postal Union " 5.00
Single Copies, - - - - - - - - - - - - - - .10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

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VOL. XVII. NEW YORK, MAY 30, 1894. No. 317.

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UNIPOLAR MACHINES.

THERE are perhaps few designers of dynamo electric machinery who have not at some period of their career tried their hand at unipolar dynamos; and the continuously recurring attempts in this direction have been looked upon as a sort of electrical measles, to which all workers in this branch are subject, but which usually pass off with comparatively little harm and thereafter grant each patient immunity from a similar attack. It must be confessed that there is some justification for this general pessimistic belief when viewed in the light of the actual results thus far obtained with this type of machine, but it by no means follows that the non-success of the past must be considered as governing the future for all time. New light is constantly being thrown on the behavior of iron, and to say that we have reached finality in dynamo design would be to ignore many experiences in a field which has even during its short period of active existence seen the most violent changes. If we inquire into the reasons for the lack of attention devoted to unipolar machines, it will be found that the most potent probably is the low E. M. F. developed by them. The simplicity and cheapness of the unipolar dynamo being conceded, it was indeed well worth while to inquire whether the low E. M. F. was an insurmountable obstacle; and we are glad to see that the subject has been taken up by so able and conservative an engineer as Prof. F. B. Crocker in connection with Mr. C. H. Parmly. The results arrived at by them, as embodied in their Institute paper, printed elsewhere in this issue, are deserving of the closest study. They show in effect that the limitations to E. M. F. are more imaginary than real and that machines for lighting and power distribution can be constructed having sizes and speeds well within practical limits. Indeed, the actual examples given by the authors may be said to be little short of startling as to the possibilities of the unipolar machine. The old objection frequently raised as to the difficulty of taking off the enormous currents generated by these machines is another of those alleged evils which a bold and original designer will probably sweep aside at the first attempt. The absence of the commutator, and of copper, from the design of such machines, must appeal strongly to the manufacturer as well as to the purchaser, so that on this score alone, if on no other, they would seem to deserve more serious consideration than has been bestowed on them hitherto. Some difficulties, of course, may be expected to be encountered, but there are probably none which cannot be overcome by a little practice in operation.

A NEW BASIS OF TELEPHONE RATES.

It is understood that the Metropolitan Telegraph and Telephone Co. of New York, is about to introduce a new system of telephone tolls, somewhat similar to that which has been in use at Buffalo, and which is in Europe, we believe, known generally as the Swiss system. The company proposes to maintain the present rate of $240 per annum for unlimited service with the best apparatus, but it annexes to this flat rate service, a toll scheme which will certainly be more equitable to small users and give everybody who needs the telephone a chance to install it. This second scale includes instruments at $150 a year, and the subscriber can have 1,000 talks for that amount. If he exceeds that number the first 100 will cost him $12, and so on. Besides this, if two men go on one line, the rate on the second scale will only be $100 each for nearly the same amount of service, or 700 messages.

Such is the broad plan, to take immediate effect on all new contracts and it will be very interesting to see how it works out. There seems no reason to apprehend anything but success. Probably the public appreciation of the toll stations has had a good deal to do with the adoption of this plan, which it should not conflict with but supplement. We expect to see, in reality, a further rapid extension of the pay station service.

A 200-ARC LIGHT MACHINE.

THE description of the new Excelsior 200-arc light machine contained in this issue is a good indication of the steady march towards increase in the size of units in central station apparatus. Whether it will be found practicable to still further increase the capacity of arc lighting machines must be left to experience, for even if the potential of such machines could be safely carried higher, the question of line insulation in cities, tapped at frequent points, must evidently be taken into consideration, more particularly where cables laid in underground ducts are employed. The success of the Hochhausen machines operating at 10,000 volts would seem to make it worth while to inquire to what extent such machines could be employed for long-distance power transmission. A plant of this description operating at 6,300 volts with 44 amperes continuous current has been in operation at Genoa for some time with good results, and there are not a few who still cling to the belief that the continuous current may yet find a place in long-distance transmission.

NEW YORK'S HOPES OF RAPID TRANSIT.

THE fact that Governor Flower has signed what is known as the Chamber of Commerce bill, has revived hopes in many quarters as to an early solution of the rapid transit problem in New York. The bill creates a new commission but as a matter of fact the new body can do little or nothing until a popular vote next Fall has decided the question whether or not the city shall raise millions of money for this gigantic enterprise; whether or not in fact the principle of municipal ownership shall be tried in combination with the principle of private lease and operation.

There are several features in the bill that will prove difficult of realization, and it is very likely that the constitutionality of the measure as a whole will soon be tested in the courts. The elevated road company may also have something to say in this direction. In the meantime, electrical engineers who are ready to build the road, overhead or underground, must, like the public, possess their souls in patience. That the road will be electrical is admitted; but its building is not so near an event as one would like.

ELECTRIC LAUNCH ACTIVITY.

The coming of spring has brought with it a most hopeful activity in the electric launch field. The example afforded at Chicago last year, on the World's Fair waters, has not been lost or wasted. Several cities are now about to start storage battery fleets, and in other places the work has actually begun. At Altoona, the first boat has been started on an artificial lake of 13 acres, around which the trip of 7 minutes is patronized by hundreds of people daily at 10 cents each. At New Haven, Lake Saltonstall, a beautiful sheet some 3½ miles long, is being equipped, and a fare of 20 cents per trip is easily obtained. At Milwaukee three boats have been put on the Milwaukee River.

In all these and other cases, the current from the trolley road is used to charge the batteries with, but it is done by means of interposing extravagant resistance. It seem to us that the proper thing would be to step the current down with the help of a motor generator or "dynamotor" of good design, and that in this new field of locomotion the street railway companies can then earn a handsome summer income.

INDUCTANCE AND REACTANCE.

The American Institute of Electrical Engineers which has already done yeoman service in securing the adoption of definite terms for several electric and magnetic quantities formerly expressed in a roundabout way, has again done good work in this direction. At the Philadelphia meeting it was voted to adopt the term "inductance" to signify what has heretofore been known as the coefficient of mutual or self-induction. The term "reactance" was also adopted, being defined as that quantity in an alternating circuit whose square added to the square of the resistance is equal to the square of the impedance. We have heard much of late on the apparent burdening of electrical nomenclature with new units, but a little consideration will show that, far from acting as a drag, these units, once thoroughly comprehended, serve to bring out clearly and to fix in the mind fundamental points in the theory and practice of designing modern electrical machinery, more particularly that of the alternating current type. We believe these new terms will find general acceptance, one indeed being already firmly established in the vocabulary of English electrical writers, namely, "inductance."

Electrical Engineer Leaflets.

In response to many inquiries on the subject, we have printed for general information, as a guide to their nature and scope, one of the Electrical Engineering Leaflets in the important series prepared by Messrs. Houston and Kennelly. We may also direct attention to the prospectus printed in our advertising pages.

ELECTRIC POWER TRANSMISSION IN FRANCE.

United States Consul Whiley of St. Etienne, France, has made a report on the extent to which electricity is applied to the industries of that city of 133,000 inhabitants. The Edison Electric Co. has, he says, established an elaborate electric plant on the River Loire, at the foot of a picturesque village, St. Victor-sur-Loire, situated about 8 miles from St. Etienne. A waterfall of 900-horse power sets in motion three turbines which transmit current through four cables, 7 millimetres in thickness, to its destination. Over sixty looms are now in operation worked by electricity furnished by this company, and a great increase in the number during the next six months is anticipated. There are 18,000 looms in St. Etienne the greater number of which are owned by the individual weavers and worked by hand in their own houses. One weaver who is the owner of two looms driven by electricity says that he can turn out 25 per cent. more work than formerly.

Near Grenoble, in the department of Isere, electric bleaching of paper pulp is extensively resorted to in the paper mills, while at Lancey, there is a paper factory worked entirely by electricity. The current feeding a motor of 200 h. p. is transmitted from a dynamo 5 miles up the river.

ELECTRIC HEATING FROM THE ENGINEERING POINT OF VIEW.[1]

BY W. S. HADAWAY, JR.

In considering the generation of heat by electricity it has been customary for electrical engineers to regard this product as waste. The question arises whether this form of energy, which is always an adjunct to other forms of electrical action, in a greater or lesser degree, may not be utilized for commercial applications of heat, either in itself, or by using the same source of supply for this purpose directly, when not in use for light or motive power.

The present system of incandescence lighting is a typical example of electric heating. A carbon filament of high resistance in a medium of small heat capacity is employed, and the energy localized at high temperatures to produce what is popularly termed "white heat," about 95 per cent. of the energy used passing off directly as heat, and the balance as light. Considered in terms of efficiency, incandescent lighting utilizes only about 5 per cent. of the dynamo output.

We are familiar with the value of the by-products from the destructive distillation of coal when used in the manufacture of illuminating gas. Heat from electricity cannot be classed as a by-product, for every manifestation of energy from electricity has an exact mechanical equivalent; but we should more carefully examine the factors entering into the production of electricity to apply the heat from electricity itself to useful work and utilize more economically the enormous heat wastes from the fuel burned in its generation.

More and more attention is being given to heat engineering in connection with steam electric plants. For economy of operation it is as necessary to regard electric plants as heat plants, as it is to recognize in solar action the origin of all our sources of heat. Where engineers are striving for highest effects in lighting and power, we can trace a disposition to consider the heat efficiency of secondary importance. In heating by electricity, on the other hand, all the energy generated is expressed in terms of the same mechanical equivalent, and properly treated on an engineering basis, will undoubtedly aid in the more effective utilization of fuel. Inspection of the figures presented before the National Electric Light Association, giving the equivalent in watts of a pound of coal is strong proof of the statements just made. One factor frequently overlooked in this connection is the time of operation, and the contour of the load line. There are few electric street railway companies that could exist if they had to charge to their operating expenses power generated at the average cost shown in the statistics of electric light stations.

In entering upon a discussion of electric heating as the art is to-day, we have three sources of supply to consider. First: The street railway plants in which the power is figured at a comparatively low rate. Second: The electric lighting plants in which the power is figured at a comparatively high rate. Third: Isolated plants in which power is figured at cost and which in most cases is a clear gain on money invested for light and power purposes. In the first case the introduction of electric heating does not affect the time of operation and offers no direct aid in increasing working efficiency. In the second case the introduction of electric heating increases the period of output, is utilized most extensively at period of least present load and consequently increases the working economy of the plant.

Technically as compared with heat energy, electricity is high potential kinetic energy. In the ordinary processes of concentration from burning coal we lose 93 per cent. and secure for useful work, capable of transference from source of supply, 7 per cent. For commercial practice in heating processes we have to balance 35,000 units of heat on the one hand with 2,565 heat units on the other, and determine whether the concentrated form for high and low temperature work, with its comparatively small *quantity* possesses sufficient value, by reason of its high potential form to be commercially comparable with lower potential forms, but greater quantities.

The common method of securing high temperatures is by the application of flame. For proper combustion the ordinary flame has to be supplied with abundance of air or oxygen. The products of combustion pass off at high temperatures, setting up convection currents which materially lower the potentiality of the heat. It has been shown experimentally that the heat units per pound of *complete* fuel, the tests including coal, coke, petroleum, wood, illuminating gas and gun powder, are practically the same. From fuel burned directly the highest absolute temperature we can hope to attain is nearly 4,000 degs. Fahr. and the efficiency will not exceed 87 per cent.

With electricity as the source of heat the temperatures attained are only limited by the cohesion of matter. There are no excessive waste convection currents; the heat can be applied to a properly selected centre of distribution, and radiated equally in all directions from the centre. It is this feature of localization that commends it as heat supply in domestic use and a vast number of industrial operations.

There are three methods by which electricity may be employed for heat purposes.

1. Directly,—the entire heat being supplied by degrading electricity through a resistance.
2. Indirectly,—electricity being employed as an agent in operating a heat engine.
3. In combination,—the heat of resistance raising a combustible to the point of ignition.

Heat generated by the first method is generally applicable to localized heating at high temperatures and in some instances to diffused heating, which will be cited further on. The second method is applicable to that class of work where large quantities of heat are required at comparatively low temperatures as in house heating. The third method is used in high temperature furnaces for muffle and crucible work, where a considerable quantity of heat is wanted at a very high temperature. I shall confine myself in this paper to consideration of the first method. Practically little or nothing has appeared in commercial work of the second method, though its importance in the development of water powers, as at Niagara for instance, is well nigh incalculable.

We have already seen that we have three sources of supply of electricity available at present: Street railway power stations, electric light and power stations, and isolated plants, and it is on the circuits of these stations that we must look at the outset for the applications of the first method of heating. On street railway power circuits, the only application available on a large scale, outside of electric welding, is in car heating.

A great deal has been said concerning this method of car heating that is misleading. It has been stated that electric railway companies could get a better income by selling their power at 2 cents per kilowatt and heating their cars by stoves. A report written for the Street Railway Convention last Fall, urged the adoption of stoves in preference to electric heaters.

In heating public buildings, schools, steam cars and dwellings we have reached the point where an equable diffusion of heat is demanded, as it is safer, more comfortable, and conduces to better general sanitary conditions. This distribution of heat either by steam or hot water or hot air is easily and economically arranged, where the space to be heated is large. But in a street car where the space to be heated is relatively small such systems are not feasible.

The very fact that makes the operation of an electric street railway possible, makes it possible to secure an equable diffusion of heat by the use of electricity. We find power figured as low as $2.00 per H. P. per month and the figures given as the "cost per car mile" in many instances appear to be figured on a basis as low as this. An expenditure of 100 watts per sq. ft. bronzed or dull black radiating surface will maintain that surface at 185 degrees Fahr. above the surrounding air. The area of radiating surface for proper heating will of course vary with the size of the car and latitude. In cars heated the past winter, 27.5 sq. ft. surface were found sufficient to properly warm a well built 20 ft. car.

On a basis of $2.00 per H. P. per month, the cost of operation would be about 27 cents per day. But in practice it was found unnecessary to run more than half the radiating surface provided a considerable portion of the time, bringing the average operating cost at about 20 cents per day. In other words in this case we secured a proper diffusion of heat by electricity and cost of operation was only 20 cents per day, while it is conceded that a stove will cost 15 cents per day to operate. The difference between the two costs surely does not compensate for foul smelling cars, unevenly heated, and a menace to health as when heated by the slightly cheaper stove.

There are many forms of car heater upon the market, but we have seen that diffusion of heat is one of the chief prerequisites of an electric heater in operation. It will generally be found that the heater which fulfills this requirement most completely is the more economical in operation. The greater the expenditure of energy by radiation and the less by convection currents the better. A convenient form in practice is a thin iron pipe with a properly insulated and distributed resistance on the inside, attached to the riser beneath the seat, and heated to about 185 degrees Fahr. Of course if cars were subject to no draughts one form of heater would ultimately be as good as another with same energy expenditure. But thermometers placed in various parts of a car frequently show differences in temperature of 5 degrees Fahr. and while, as a usual thing in space heating, the hotter the source the greater the efficiency, in car heating the greater the percentage of heat we can diffuse in the body of the car, in preference to the monitor, the better.

I therefore claim for the electric car heater the same high grade heating results in small draughty cars as we secure in carefully arranged heating plants of large dimensions; a large quantity of air moderately heated and consequently good ventilation. These factors warrant the use of electric heaters in preference to stoves even at a very largely increased cost.

The main sources of supply of electricity for industrial and domestic applications are the electric light and power stations and isolated plants. It is in conjunction with the use of the station equipment for lighting and power that electric heating develops maximum station efficiency. I have already alluded to the inefficiencies of these stations as reported recently before the National Electric Light Association. Careful study of the reports of the Massachusetts State Board of Gas and Electric Light Commissioners gives us the practical results of this manner of operation. These reports show that the money invested in electric stations, and particulary the smaller ones, is not properly remunerative.

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[1] Abstract of a Paper read before the New York Electrical Society at Columbia College on May 10, 1894.

Professor Thurston shows an average boiler efficiency of about 65 per cent. as the results of many series of tests and some very good boilers have been found to exceed seventy per cent. efficiency. The efficiency of a perfect engine working between the boiling point and the freezing point of water is $\frac{100}{374}$. In practice it is impossible to keep the condenser at a much lower temperature than 110 degrees Fahr., which at average pressure gives a theoretical efficiency of about one-fourth. In practice one-half this efficiency is rarely exceeded, showing that as a heat transformer, an engine has a value of only about one-fifth that of a boiler.

Considered then as a heat station, we should use electricity for temperatures from 300 degrees Fahr. upwards and both live steam and exhaust steam for temperatures below this limit. The best figures of operation I have found are results obtained in England, which show a H. P. hour on consumption of 1.3 lbs. coal per hour, or a heat efficiency reckoning from coal, of practically 14 per cent. The average of what is commonly called good practice is about seven per cent. Obviously in station practice high prices must be obtained for energy sold and the average figure found is $150 per electrical H. P. per year, as against the best mill practice ranging from $18 to $35 per H. P. per year. Of course transmission losses and fixed charges on electrical part of equipment should be counted in.

On an average I find that the electrical H. P. hour costs four times what the mechanical H. P. hour is sold for. Large dynamo efficiencies exceed 90 per cent., showing that this excess charge must be due, conditions being equal, to a variable load line of extreme irregularities. We have as yet insufficient data from industrial and domestic applications of electricity for heating to construct a representative load line, but we know that time of maximum cooking is at time of least lighting, and vice versa, and that industrial applications of heating by electricity are a supplementary motor load.

We have seen that electricity generated from coal represents a heat efficiency of about 7 per cent. In practical applications therefore, we are limited to work where high constant temperatures are a desideratum or where present efficiency of fuel is less than this figure. The most complete published tests regarding efficiency of the common house range of which I am aware were published in *Science* for September 15, 1893. The author gives results of a long series of tests. In summarizing, the total *cooking* efficiency is given as 2.7 per cent. and the total all-day efficiency plus water heating efficiency as 4.2 per cent. These figures have been closely confirmed by English observers and 4 per cent. may fairly be regarded as a good working value for average range efficiency.

We see that notwithstanding great inefficiencies in operation, electricity can be delivered at a rate of 7 per cent. efficiency from central stations as against 4% from coal directly burned in ranges. If we could eliminate the water boiling factor electricity for cooking would be far cheaper than coal or gas. This difficulty in practice will have to be met by a water heater, heated directly by coal. It is this difficulty in the application of heat of simple resistance for cooking that causes me to look with confidence towards thermo-electric devices in which electricity is derived directly from heat and the diffused or scattered heat utilized in water heating for house warming, baths and cooking. If my data is correct these devices are already made in France with an electrical efficiency exceeding four per cent., which with the water heating device added will bring the total heat efficiency to practicable figures.

At the outset cooking by electricity will generally be found more expensive than cooking by coal. But the advantages attendant upon its use compensate for a wide disparity in price. I have been assured by a representative hotel man that if the cost exceeds coal cost four times, hotels will use electricity in cooking on account of cleanliness, facility of regulation, constant temperatures, cooler kitchens and better general work.

Installations of cooking apparatus demonstrate the success of electric cooking both as regards cost and simplicity of operation. An installation in this city operating since Jan. 1st has proven conclusively that theoretical deductions are not far-fetched and that electric cooking can no longer be regarded an experiment or a fad. This plant consists of an oven of two compartments, broiler of three sections, portable stoves of various sizes, teakettle and farina boiler, which have heaters directly attached to them, and plate warmer. The cooking operations are carried on beneath a hood ventilated by a fan driven by a motor, and the kitchen is very comfortable as a dining room. At the rate of five cents per horse power hour the cost per person per day is about two cents. At the rate of 2½ cents per H. P. hour, which may be considered a fairly representative price from water power stations, cost per person per day would be about one cent and from an isolated plant, directly operated, cost per person per day would be about ¾ cent.

Cooking by electricity will be found of greatest convenience during the Summer and it is at this time that the central station has least load for lighting, showing again how a careful study of heat conditions will increase working economy. In fact a central station, burning large quantities of fuel, can supply a community with all its heat, both Summer and Winter, at a profit, and the character and size of these stations at present bear to future developments in this line about the same relations as an artesian well to a complete system of water supply.

I have read a great many able papers on the value of using exhaust steam in space heating in preference to heating feed water, but engineers are loath to undertake to supply more than one commodity from the same source. It seems incredible that with the excellent results demonstrated in practice, we see so little space heated by exhaust steam, from electric light stations. By using electricity for high temperatures and exhaust steam for diffused heats a total heat efficiency of 35% is practicable, and with light, power and heat of varying potentials from the same source, capital invested in stations will be found more remunerative.

The use of the simple heat of resistance for room heating is not generally economical except in a case like car heating where heat transference by electricity satisfies other requisite conditions than can be supplied by heat of fuel directly used. Heating by electrical resistance is essentially heating by friction and no one would think of setting up a steam engine or water wheel with a brake on the fly-wheel to heat a building.

On a large scale the indirect application of electricity is the only feasible way of employing electrical energy in this work. We find in practice however, a surprisingly large number of places where a simple electric heater is of greatest convenience as auxiliary to other methods of heating. No one can foretell how far this practice will extend as the convenience of electric heaters become better known and the cost of electricity cheapens. Every electrical engineer knows that in practice apparatus of highest efficiency oftentimes meets with poorer success than less efficient apparatus, because more than one requirement has to be fulfilled and so in direct electric heaters a heater for occasional use is being found of great value notwithstanding relatively great cost of operation.

It is frequently stated that heating buildings by electricity generated by water power is practicable. For space heating coal at $5.00 per ton burned under a good boiler and distributed throughout building by direct steam, is on a parity with the electrical horse power at $4.00 per year. I know of no instances where power can be sold at this rate; in fact interest cost on electrical plant usually equals this figure. In some places, as in Southern California, where its use is for warming in distinction to heating, it has been shown feasible to use water power for room heating, and in fact in heating small offices, bath rooms, bed rooms, etc., direct electric heaters are coming into considerable use. We may term them all, however, special cases, but may fairly state that in communities of like character the extent of use will be directly proportional to relative costs of electricity.

In the operation of isolated plants in mills, hotels, etc., electric heating will open up a multiplicity of applications so that we may expect elimination of flame for heating as well as lighting. In hotel work we have probably the opportunities for most economical utilization of fuel as well as materially improving existing conditions. Using electricity for boilers, fat friers, griddles and ovens, and live steam for kettles and pots, and exhaust steam for heating steam tables, coffee urns, etc., and surplus for room heating in winter and feed water in summer we approach complete practice.

By immersion heaters we may heat all sorts of fluids and bodies that liquify at temperatures not exceeding 500 F. There is found to be absolute safety, easy heat variation, proper diffusion for uniformity of temperature and economy in this practice. In fact the industrial applications of electricity as a fuel appear almost unlimited, and even at the high cost per heat unit commonly charged electrically heated apparatus is rapidly coming into use.

In the foregoing I have shown the limitations and possibilities of useful work from heat transference by electricity. We have seen that the field of use is an actual one on questions of efficiency, equable distribution and convenience. The value of high potential heat energy to central station men has been pointed out. Electric heating should be recognized in central station work as an additional outlet for power and grasped and exploited as such. It was not simply the desire for electric lights that induced so many people to use them; but an aggressive campaign on the part of the station men as a source of revenue. With electric heating apparatus some of the most progressive will have it anyway; but in summer work, its value will be fully shown only by a determined effort to sell current to restaurants, cafés and dwellings. The manufacturer cannot be expected to do this work; but by proper coöperation good results will be reached of value alike to the manufacturer, central station and customer.

H. S. Wynkoop, M.E., has been appointed inspector of gas and electric lights for the city of Brooklyn. He will, however, retain his connection with the Electrical and Mechanical Engineering & Trading Company, of 39–41 Cortlandt street.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE JOHNSTON RAIL BOND.

While the value of a good ground return circuit for electric railroads was early recognized by electric railway companies, the absolute necessity therefor has only comparatively recently been brought home to electric railway managers. Our columns have recently contained numerous references to the destructive electrolytic action which attacks metallic pipes operated underground in proximity to railway circuits, and electrical engineers themselves are now no longer justified in denying this action, which at first was thought to be problematical. To keep the current as far as possible out of the ground ought therefore to be the aim of electric railway engineers.

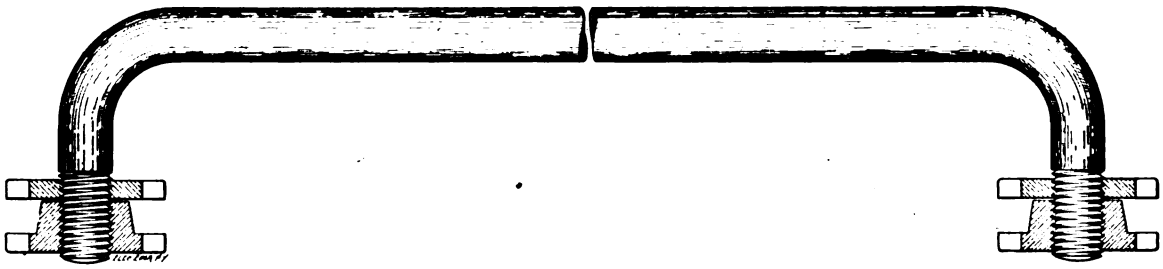
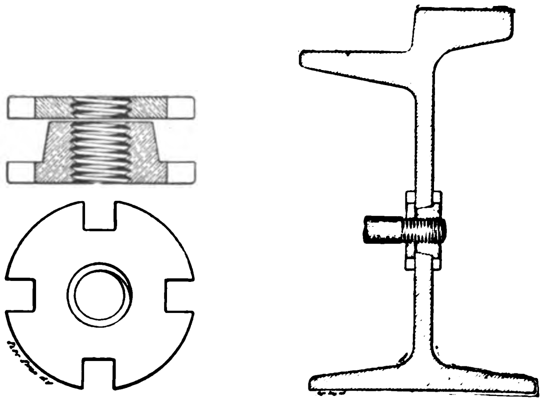


Fig. 2.—The Johnston Rail Bond.

In addition to this objection there are other serious defects which a bad return circuit gives rise to, and among them, a low potential on the line. With the E. M. F. low, the current required to operate a car is considerably increased and this increased current is frequently beyond that for which the motor is designed. The result is, burnt-out armatures and frequent repairs—not to speak of the heavy drain on the coal pile at the station.

In the vast majority of cases the rail itself is of sufficient sectional area to carry back safely all the current required for the operation of a road, and it follows, therefore, that if the current can be confined to the rail exclusively, no destructive external effect will be encountered. Unfortunately, however, tracks include rail joints and this has thus far stood in the way of a realization of the ideal track return. To make the track as far as possible of continuous and uniform conductivity, rail bonds have been introduced in the past, which have, without doubt, considerably increased the effective carrying capacity of the rail.



Figs. 1 and 3.—The Johnston Rail Bond.

By making the sectional area of the bond itself of sufficient carrying capacity to take care of all the current returning to the station, the necessary condition for conductivity would at first sight seem to be fulfilled; but further consideration will show that another element enters here which seems to have been overlooked in the past, and that is, the nature of the contact between the bond and the rail.

The usual method employed is to rivet the bond, or to use channel pins; but with such devices, evidently, the contact obtainable is only equivalent to that of the surface area of the hole in the rail. Now it is well known, that in order to insure full carrying capacity a contact ought to have ten times the area of the conductor to which contact is made. It was to insure this increased contact that Mr. A. Langstaff Johnston designed the rail bond illustrated in the accompanying engravings, and which represents the experience gained by him in seven years' experience in electric railway work, beginning with the installation of the pioneer Sprague road, at Richmond, in 1887.

In the Johnston rail bond all rivets are avoided and the bond is applied to the rail by means of two nuts, shown in Fig. 1, which are applied to the ends of the bond, as shown in Fig. 2. The web of the rail is perforated by a taper hole, and after the insertion of the bond the nuts are screwed up tight and force the tapered nut into the hole, as shown in Fig. 3.

It will be evident that the increased diameter of the hole in the web together with the faces of the nuts, gives an area of contact far in excess of that of the cross-section of the bond itself, and in the present instance the dimensions have been so chosen that the surface in contact with the rail is twelve times the cross-section of the bond.

The size of the wire used in connection with the Johnston bond can of course be varied at will, those nearest the power house being made larger to take care of the increased current at that point; this can be done, however, without altering the bond nut, all that is necessary being to tap it to the size of wire desired.

The Johnston rail bond is made by the Car Equipment Co., of 741 Drexel Building, Philadelphia, Pa.

THE THREE-WIRE TROLLEY SYSTEM AT PORTLAND, ORE.[1]

BY A. C. BALCH.

The street railway systems of Portland, Oregon, receive the greater part of their power from the Union Power Company. In order to obtain cheap fuel, the station of the Union Power Company was placed near a large saw mill, and the refuse from this mill used. The distance between the station and the centres of the systems supplied with power is about three miles and, at times, the load upon the station approximates 1,500 horse power. Early in the course of estimating the probable cost of installing the electric systems, it became apparent that if the station were to be placed near the saw mill, to take advantage of the cheap fuel, the extra cost for feeders would be considerable. To reduce this cost it was decided to adopt the three-wire system of distribution. This had been shown to be a success in lighting work, but had not been previously tried in the actual every-day operation of street railways, at least so far as was known to the writer, who was the engineer in charge of the installation of the station. There is now no doubt of its entire success, as the plant has been in operation on the three-wire plan more than two years without any delay whatever, chargeable directly or indirectly to its use. Further, a direct illustration of one of its advantages was had as follows: Part of the system supplied with power was in readiness and in use some months before the whole system was completed. This section had eleven double reduction Sprague motor equipments in operation and the feeders supplying the power were arranged on the ordinary plan for railway operation, but were calculated to run seventeen cars after the whole system should be completed. As the feeders were figured on the three-wire basis, it was found necessary to run the voltage at the generators at 600 volts, and, even then, at times, the voltage on the line fell to 350 volts. When the whole system was put in operation no change was made in the number or arrangement of the feeders for this section, the six cars were added, the voltage at the generators was lowered to 550, and yet the voltage at the cars never fell below 450 volts.

At the Washington convention of the National Electric Light Association, Mr. J. H. Vail read a paper advocating a complete metallic circuit for street railways. His plan involves the use of track feeders. The three-wire plan accomplishes his results with a saving in wire of over fifty per cent.

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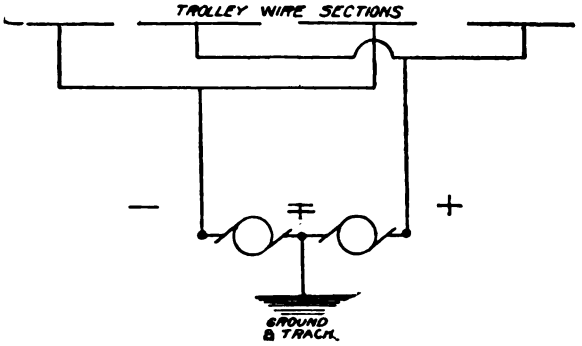
[1] From the *Street Railway Review.*

Several companies operating water works in cities where electric traction is employed have complained bitterly of the electrolytic action caused by stray currents, or the use of the water pipes as an additional ground. In answer to a query from Omaha water works officials, as to the methods employed in Portland to obviate the pitting caused by electric action, the superintendent of the Portland company replied that no such trouble had occurred. The reason for this is, that the return circuit is all copper, and there is a pressure exerted to make the current take this path in preference to the water pipes.

The wiring of the car, the overhead construction, the track, in short all the installation outside of the power house is done according to ordinary two-wire usage. Each feeder, or set of feeders, supplies a section. This section is insulated from the adjoining sections. The track is the neutral. Alternate sections are of opposite polarity and there is a difference of potential of 1,100 volts between the sections of trolley wire. The station installation is according to ordinary three-wire lighting usage, except that no compensating or potential regulating devices are used on the feeders.



THREE WIRE ELECTRIC RAILWAY SYSTEM.

The operation of the dynamos does not differ from the operation of the same machines in ordinary railway usage.

Among the advantages over the present two-wire usage are fifty to sixty per cent. saving in copper for installation, no electrolytic action on gas or water pipes, and a complete metallic circuit. To offset these manifest advantages, the writer has yet to discover a single disadvantage, although the system has had a two years' trial in all kinds of weather and under all the conditions met in street railway work.

In conclusion, the three-wire system seems peculilarly adaptable to installations in cities like Philadelphia, where, in many instances, single tracks are laid in parallel streets; to double track roads, using a pole between the tracks to support the trolley wires and with slight modifications to long distance suburban lines.

ELECTRIC RAILWAY FROM NEW YORK TO WASHINGTON.

A BILL permitting the construction of an elevated electric railway between Washington and New York, has been introduced in the House of Representatives, at Washington, by Mr. Catchings, of Mississippi. It is designed to run trains at the rate of 120 miles an hour over this road. The company is to be capitalized at $15,000,000, and the charge for transporting passengers is not to exceed two cents per mile. The National Rapid Transit Co. proposes to build the road, but does not unfold any very definite scheme. Among the well-known men interested are: S. M. Bryan, Hamilton Disston, V. D. Stockbridge, Moses Sweetser and Noah L. Jeffries.

THAT $50,000 TRACTION PRIZE.

In your issue of May 16th you state that the State Railroad Commissioners have now been authorized by law to act as the authority to award the $50,000 prize offered by the Metropolitan Traction Co. I desire to refer you to an interview with J. D. Crimmins, which appeared in the New York *Herald* May 3rd, in which he is made to say as follows: "Nothing having been accomplished by February 1st, and as our $50,000 offer no longer held good * * * we start out on a new tack." It appears that this law might as well be left off the statute books.

For myself I have believed from the first perusal of the requirements for the obtaining of this prize that the offer was not made in good faith. Capitalists have obtained a complete knowledge of nearly every possible way of running an electric road without the trolley wire at no expense to them but simply by the use of a colossal bluff.

This is the position that Mr. Crimmins is now in and he must remain guilty of having resorted to a trick, or renew this prize offer by extending the time at least one year from date, and the money had better be put in some disinterested party's possession, else he will fail to reach some practical scheme for running his cars other than with a overhead trolley.

F. MANSFIELD.

PHILADELPHIA, PA., May 19, 1894.

STREET CARS WITH BUTTONS.

Some of the electric railway companies in the state of Kansas have equipped their cars with push buttons for the convenience of passengers wishing to attract the conductor's attention. It is easier to press a button than to pull a strap and more in accordance with the spirit of electric progress.

LEGAL NOTES.

GENERAL ELECTRIC CO. vs. FRANK Z. MAGUIRE et al.

Vice Chancellor Bird has granted an injunction against Frank Z. Maguire, Frank A. Magowan, and others of this city at the suit of the General Electric Company, which seeks possession of one-half of $150,000 of the common stock of the Trenton Light and Power Company which stock, it is claimed, was issued to Maguire and Magowan at the time the new electric light company started by them consolidated with the People's Electric Light Company under the name of the Trenton Light and Power Company. The injunction restrains the disposal of this stock until the Chancellor shall decide as to whether the complainants are entitled to any relief or not. The bill of complaint states that through Maguire, not in his individual capacity, but as agent of the General Electric Company, and therefore under an agreement between Magowan and himself to divide the profits, the company is entitled to one-half of the $150,000 worth of stock issued to them on account of the new company.

LITERATURE.

The Practical Electroplater. By Martin Brunor. Cloth and morocco. 298 pages. Many Illustrations. New York. Emile Brunor. Price $10.

The plater's art was one of the first in the electrical field and now has a well-established place. Many electrical engineers engrossed with more recent developments do not give it a very prominent place in their thoughts and are certainly not very well acquainted with its literature. In fact, that so extensive an industry should be so little represented by new and available books on the subject is rather remarkable, especially when we remember that modern electric lighting grew largely out of the work that such men as Brush, Weston, Wallace and Hochhausen had done in the electroplating field with their earlier dynamos. There certainly has of late been a real and crying need for a practical treatise on the art, something that plain, everyday platers could study with ease and make their own. We are glad to know that some electrical engineers have in recent years been paying closer attention to plating, typing and deposition problems, but none of them has favored the public with any kind of help in dealing with the details of the art. At this stage, Mr. Martin Brunor, a well-known plater in New York, has come forward, and in the present handsome volume has given to his brethren the fruits of twenty years of practice, study, experience, observation and reading. Whatever might be the defects of such a book, its merits could not but be considerable; and while the price seems high, we can readily believe that it will be worth its weight in refined gold to those who wish to do good plating work. As Mr. Brunor says, very frankly, he appeals to the worker and plater rather than to the scientist, and his pages are filled to overflowing with that solid, well digested data that every master of his trade must be in possession of if he would achieve the highest possible success.

All classes of work are carefully touched upon and dealt with, and formulas for solutions are abundant under all the heads of gold, silver, copper, nickel, bronze, brass, etc., and partially completed metal work for oxidizing and many special topics are discussed that we have never seen handled before, while others more familiar are treated in a very satisfactory, thoroughgoing style. Mr. Brunor moreover is generous in the credit given his collaborators, including Mr. P. M. Furlong, Dr. W. H. Wahl, Prof. Crocker, Dr. S. S. Wheeler, Mr. J. Swinburne and other technical experts. It would be impossible without devoting several pages to it to go into the details that Mr. Brunor treats upon, but we may say that his book contains a wealth of curious, interesting and valuable information that we would hardly know how to put our hands on anywhere else. The get-up of the book is unimpeachable in every respect.

ELECTRICAL ENGINEERING LEAFLETS.[1]

BY PROF. E. J. HOUSTON, PH.D., AND A. E. KENNELLY, F.R.A.S.

No. 1—Elementary Grade.

ELECTRICAL EFFECTS.

1. If on a dry day, a hard rubber comb be briskly rubbed on a dry coatsleeve, the comb will be found to attract light pieces of paper. Under favorable conditions a crackling sound will also be heard, and if the experiment be tried in the dark, bluish flashes of feeble light will be seen round the comb. If, after various rubbing the comb be drawn near the face, a peculiar sensation will be experienced like that of the passage of cobwebs over it. These are some of the effects produced by electricity.

The same effects are intensified if the comb be rubbed upon a piece of catskin or fur, instead of upon the coat.

2. A leather belt moving rapidly over a pulley, will, under certain conditions, produce powerful electrical effects, and if a knuckle of the hand be held near the belt, sparks will appear between the knuckle and belt, accompanied by a sharp crack and a more or less severe shock to the experimenter.

3. When a lightning flash passes between two neighboring clouds, or between a cloud and some object on the earth, a sharp report—thunder—accompanies the flash and occasionally a peculiar smell is presently observed. When the conducting path offered for the lightning discharge is insufficient, destructive effects such as the rending or tearing of timber, the splitting of masonry, or the melting of metal work occur.

4. When the comb is rubbed over the coat we obtain what is called an *electric charge*, and we charge both the comb and the coat. When a spark passes between comb and coat, from belt to knuckle, or from cloud to earth, we see some of the evidences of an *electric discharge.*

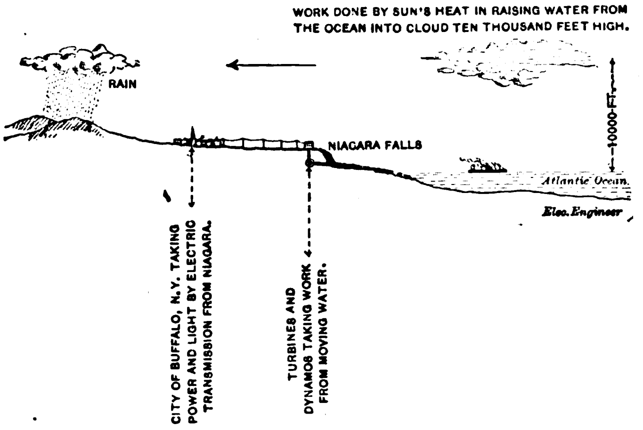

WORK DONE BY SUN'S HEAT IN RAISING WATER FROM THE OCEAN INTO CLOUD TEN THOUSAND FEET HIGH.
RAIN
NIAGARA FALLS
10000 FT
Atlantic Ocean.
Elec. Engineer
CITY OF BUFFALO, N.Y. TAKING POWER AND LIGHT BY ELECTRIC TRANSMISSION FROM NIAGARA.
TURBINES AND DYNAMOS TAKING WORK FROM MOVING WATER.

FIG. 1.

An electric discharge produces a momentary *electric current.* If electric discharges follow one another with sufficient rapidity they lose their momentary character, and may develop into a steady electric stream or current.

5. *Dynamo electric machines*, as is well known, produce powerful electric currents. These currents heat the armature of the dynamo to a degree readily perceptible to the touch; are able to raise the temperature of the filament of an incandescent lamp so that it shines; may fuse a conducting wire when that wire is too small, and can produce a luminous discharge, called the "*arc*," between carbon rods in an arc lamp. If accidentally passed through the human body, such currents may produce severe injury or even death.

Besides the above electric effects, there are others not yet mentioned. If a bar of iron be approached to the magnets of a dynamo while it is producing electric current, a strong magnetic pull will be felt on the iron. This effect is due to the magnetic action of the electric current passing through the coils of wire round the magnets. Magnetism, therefore, is one of the effects produced by electricity.

6. When an electric current is led through a bath containing an electroplating solution, metal is separated from the solution and deposited upon objects suitably connected to the leading-in wires. Chemical decomposition caused by electric currents is called *electrolysis*, which is, therefore, another electric effect.

7. Electric discharges, therefore, produce a variety of effects which may be classified as follows:

1. Luminous, as in the electric spark or light.
2. Heating, as in fusing wire or warming an armature.
3. Mechanical, as in effects of lightning discharge.
4. Physiological, as in shock to human body.
5. Magnetic, as in the attraction of a bar of iron by dynamo magnets.
6. Electrolytic, as in electroplating.

8. A cart or car never moves of itself on a level road, but must be pushed or pulled. A clock to continue to run, must either have its weight raised or its spring wound up. A locomotive steam engine cannot run on a level unless driven by steam produced by the action of heat on the water in a boiler.

To permit water to fall out of a vessel it must first be raised into the vessel. The water which flows down to the sea through a river channel has first to be lifted by the sun's heat as vapor from the ocean, and deposited as rain on the high lands where the river begins. (Fig. 1.).

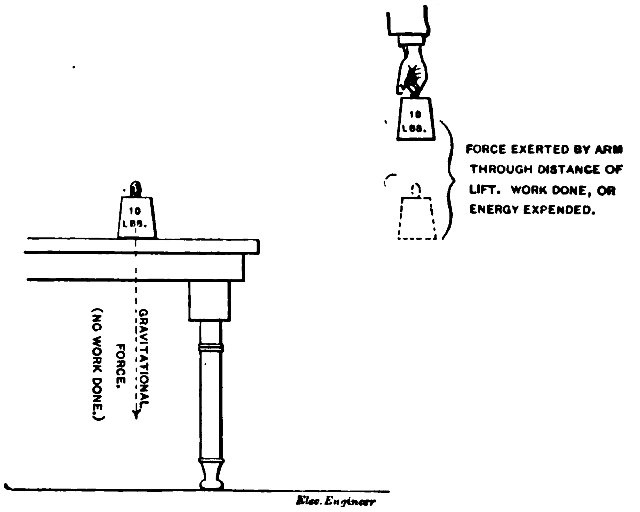

10 LBS.
GRAVITATIONAL FORCE.
(NO WORK DONE.)
10 LBS.
FORCE EXERTED BY ARM THROUGH DISTANCE OF LIFT. WORK DONE, OR ENERGY EXPENDED.
Elec. Engineer

FIG. 2.

An incandescent or arc lamp will not shine, nor an electric motor run, unless supplied by an electric current.

The speed with which a ball leaves a gun depends upon the amount of powder used in the gun barrel. The power of the ball to overcome obstacles, comes from the heat produced by the burning of the powder.

Muscular power in any animal is derived from the food the animal consumes, which food is slowly burned away in the animal's body.

9. In all these cases *work* has been done as is shown by matter having been moved through a distance, and in order to produce the motion, some force has been brought to bear upon the body. The cart or car on the level road required to receive a push or pull; the pendulum of the clock needed the action of a weight or spring; the locomotive steam engine required to be driven by pressure of the steam against the piston in the cylinder; the water to fall out of the vessel required to be acted on by the earth's attraction, *i. e.*, by gravity; the water in the river, in order to flow through its channel, requires gravitational force; the ball in the gun barrel, in order to be set in motion, requires the pressure of the expanding hot gases in the barrel.

10. But in none of these cases is work done unless the force acting on the body causes the body to move. A weight resting on a table produces a pressure or force upon the table, but no work is done so long as it remains at rest; but as soon as the table is withdrawn from beneath the weight, the force of gravity moves the weight through a distance; *i. e.*, to the ground, and does work. (Fig. 2.)

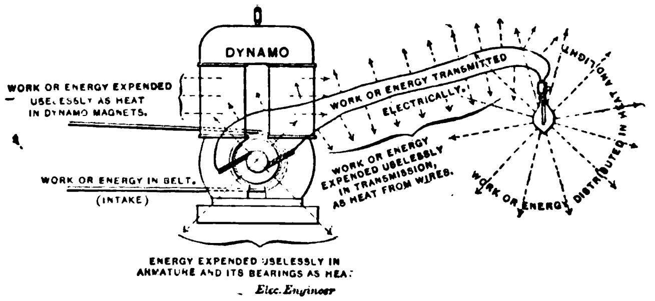

DYNAMO
WORK OR ENERGY EXPENDED USELESSLY AS HEAT IN DYNAMO MAGNETS.
WORK OR ENERGY IN BELT. (INTAKE)
WORK OR ENERGY TRANSMITTED ELECTRICALLY.
WORK OR ENERGY EXPENDED USELESSLY IN TRANSMISSION, AS HEAT FROM WIRES.
WORK OR ENERGY DISTRIBUTED IN HEAT AND LIGHT
ENERGY EXPENDED USELESSLY IN ARMATURE AND ITS BEARINGS AS HEAT
Elec. Engineer

FIG. 3.

11. In no case is work done, *i. e.*, by force acting through a distance, without drawing upon a stock of previous work. The cart or car moved along the level road, required work to be done on it by an animal, and this store of work in the animal was obtained from its food, which in its turn received its store of work from the sun's light and heat.

The clock, in order to do work, required to be wound up, say by a man, who obtained his store of work in the same way, and there is less work in a man or animal after exerting force through a distance than there was before; the man or animal, therefore, requires to eat in order to replenish his stock of work.

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[1] The accompanying Leaflet is printed from advance sheets as an illustration of the nature and scope of this new and important educational work.

The locomotive steam engine, or any steam engine, has to burn coal in order to obtain the work it exerts, and the coal in its turn, received its stock of work from the sun's light.

The water in the river can only fall towards the sea by the work done on it by the sun's heat in lifting it from the sea to the clouds.

The incandescent or arc lamp can only shine and produce its heat and light; *i. e.*, work, by the work done on it by the electric current, which received its store of work from the dynamo, which received its store from the steam engine, which again received it from the coal, and this finally from the sun's rays.

Work is consequently never done without drawing upon a stock of previous work. All machines are devices for transferring work from a store or stock where it is not wanted; for example, from the work of the sun's rays in coal, to where it is wanted, namely in a steam engine.

It should carefully be borne in mind that electrical work, *i. e.*, work performed by electricity in producing any electrical effects, is no exception to this rule; such work has to be paid for by the expenditure of some other store of work, such as work in coal with a steam engine, or in moving water with a water wheel, or chemical work in a voltaic battery.

12. In this general sense, work is never lost, but only transformed. It is believed that the total store or stock of work in the whole universe is constant. When any work disappears in one form it must reappear in another form. For this reason the work done by the machine can never exceed the work it withdraws from other sources. In point of fact, the amount of useful work done by the machine is always less than the work it absorbs, for the reason that in the transformation some of the work is sure to appear in a form which cannot be usefully employed. Thus the work done by a steam engine is less than the work it absorbs, partly by reason of the friction of its moving parts, which friction transforms that amount of work into heat at the rubbing surfaces, where it cannot be usefully employed. (Fig. 3.)

It would be as hopeless to attempt to withdraw from a machine electrical or otherwise, more work than it absorbs, as it would be to expect to draw, without refilling, a quart of water out of a pint vessel, and any attempt to produce a machine, electrical or otherwise, which will continually move without absorbing work from some store or stock, is as futile as to attempt to fill the Atlantic Ocean from a simple pitcher full of water.

13. The work *done on* a machine in driving it, is termed its *intake of work*, and the *useful* or *available* work *done by* the machine is termed its *output*.

The output can never exceed the intake; in fact it can never practically even equal it.

The amount of work performed in any case is nearly always measureable, whether it exists as heat, electricity, magnetism, chemical power, or muscular power, and can be expressed as a weight moved through a certain distance.

The amount of work required to produce any ordinary electric effect, such as lighting an incandescent lamp, depositing metal in a bath, or driving a motor, is fixed and definite, and can, in most cases, be readily measured, so that the amount of coal which must be burned in a good steam engine to produce a given electric effect can be arrived at.

Any attempt, for instance, to produce a primary battery, or any other electric device, which shall work for an indefinitely long time, without constantly requiring replenishing with a corresponding amount of work, is as futile as the attempt to produce perpetual motion without the continual absorption of energy.

LABORATORY OF HOUSTON & KENNELLY, }
PHILADELPHIA, April 2, 1894. }

D'ARSONVAL'S HORIZONTAL MAGNET INSTRUMENT.

THE horizontal magnet of D'Arsonval, manufactured by Queen & Co., Philadelphia, is an extremely valuable instrument for making insulation resistance tests on wires and cables. For the most of this work, it is much superior to the Thomson mirror galvanometer and costs less than half as much. On account of its very pronounced dead beat qualities, measurements are made quickly and it being but little affected by vibration and not at all by external magnetism, it can be employed where the Thomson would be utterly useless. It is commonly supposed that a Thomson is vastly more sensitive, but this is not the case. With the 1,000 ohm coil D'Arsonval a sensibility of 315 megohms can be obtained. An exceedingly valuable feature is the arrangement for interchanging coils for different classes of work. To do this it is only necessary to draw out one tube and insert the other, the instrument then being ready for use.

Among prominent users are the Philadelphia Traction Co., the Electric Traction Co., of Philadelphia, The Standard Underground Cable Co. and Roebling & Sons. Full information in regard to this instrument, which for workshop use is very much superior to other forms of galvanometers, may be obtained by writing to Queen & Co.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 22, 1894.

Alarms and Signals :—

Railway Signal Device, F. E. Kinsman, Plainfield, N. J., 520,061. Filed Feb. 1, 1893.

Has for its object to give the locomotive engineer notice that the controlling apparatus on the line is in working order on passing a point where, should conditions require it, the locomotive would be automatically stopped.

Apparatus for Controlling the Movement of Railway Trains or Vehicles, F. E. Kinsman, Plainfield, N. J., 520,062. Filed June 28, 1893.

An automatic electric signal device especially adapted to steam railways.

Electric Annunciating Apparatus, H. E. Walter, Richfield Springs, N. Y., 520,127. Filed July 23, 1891.

Electric Advertising or Signaling Apparatus, G. L. Schneider, San Francisco, Cal., 520,223. Filed Jan. 20, 1894.

Indicator for Fire Alarm or Other Purposes, W. H. Kirnan, Bayonne, N. J., 520,234. Filed Jan. 18, 1892.

Visible Signal Device, W. H. Lane, Brooklyn, N. Y., and F. S. Perrin, New York, 520,365. Filed March 12, 1894.

Conductors, Conduits and Insulators :—

Insulator, F. M. Locke, Victor, N. Y., 520,367. Filed Dec. 4, 1893.

An insulator having horizontal annular grooves and a multiplicity of downwardly extending annular ridges.

Distribution :—

System of Electrical Conversion and Distribution, T. H. Hicks, Detroit, Mich., 520,050. Filed Dec. 15, 1892.

Employs a converter and two work circuits the former having two separate commutators. The primary circuit is supplied with rectified current from a main line generator while the secondary circuit supplies the two work circuits with alternating and with rectified currents respectively.

Dynamos and Motors :—

Pedal Governor for Electric Motors, A. G. McKee, State College, Pa., 520,072. Filed July 13, 1893.

Adapted especially to small dental motors and the like.

Former for Winding Armature Coils, H. L. Kirker and W. Chambers, Pittsburgh, Pa., 520,143. Filed Nov. 26, 1894.

Dynamo Electric Machine or Electric Motor, R. K. Welch, Philadelphia, Pa., 520,152. Filed June 24, 1891.

Employs a commutator consisting of a central disc for application to the armature shaft, and a series of segments secured to and projecting radially beyond the disc.

Brush Holder for Dynamo Electric Machines or Motors, A. L. Riker, New York, 520,169. Filed Mch. 31, 1894.

Claim 2 follows:

A brush-holder comprising two contact plates connected at each end by two parallel ends.

Commutator, C. Hoffmann, Berlin, Germany, 520,264. Filed Sept. 28, 1893.

Claim 1 follows:

The combination with a commutator bar comprising separable elements, of an individual retaining key common to the bar and the separate elements thereof.

Electrical Governor, W. H. Miller, New York, 520,267. Filed June 18, 1894.

Comprises a magnet, an armature, means for connecting the armature with the adjustable brushes of the dynamo, and mechanism for maintaining the pull of the armature constant irrespective of the operative relation to the magnet.

Galvanic and Thermo-Electric Batteries :—

Electric Battery, W. W. Burnham, Newton, Mass., 520,083. Filed Sept. 7, 1891.

Relates to methods of supporting the elements in the jar and holding them properly separated from one another.

Galvanic Battery, E. F. Northrup, Ardmore, Pa., 520,120. Filed Feb. 18, 1893.

Employs an electrolyte paste containing a base capable of producing hydrogen and an oxide base by reactions within the cell, a depolarizer in contact with the negative electrode consisting of sulphur iodine.

Lamps and Appurtenances :—

Incandescent Lamp, F. S. Smith, Pittsburgh, Pa., 520,088. Filed June 28, 1893.

Has for its object to produce an intimate contact between the glass and the leading-in wire along the entire length of the seal.

Electric Arc Lighting System, D. Higham, Boston, Mass., 520,232. Filed Jan. 2, 1894.

Employs an inductive coil in the main circuit in series with the arc and series windings of the lamps, and an elastic connection between said mechanism and the frames of the lamp,

Measurement :—

Electric Current Indicator, J. J. Wood, Fort Wayne, Ind., 526,129. Filed Feb. 6, 1894.

Employs a compensating magnet arranged to exert a counter repulsion and to resist the tendency to a disproportional movement of the armature actuating the index lever as the current increases.

Electric Measurement Instrument, R. M. Hunter, Philadelphia, Pa., 520,361. Filed Apl. 13, 1894.

A self compensating voltmeter for central station work intended to be accurate for all variations of atmospheric temperatnre.

Metal Working :—

Apparatus for Heating Metals Electrically, C. L. Coffin. Detroit, Mich., 520,299. Filed Oct. 5, 1893.

Method of Heating, Welding, or Working Metals Electrically, C. L. Coffin, Detroit, Mich., 520,300. Filed Oct. 7, 1893.

Consists in subjecting the metal to the influence of a moving voltaic arc while simultaneously heated by radiation from incandescent electrodes not in contact with the metal.

Apparatus for Electric Welding, R. M. Hunter, Philadelphia, Pa., 520,359. Filed Oct. 12, 1893.

Relates especially to the welding of the webs of girder rails.

Apparatus for Electric Welding, R. M. Hunter, Philadelphia, Pa., 520,360. Filed Oct. 12, 1893.

Similar to No. 520,359.

Miscellaneous :—

Transmitting Sound, H. B. Cox, Hartford, Conn., 520,106. Filed Aug. 6, 1890.

Relates to methods of transmitting sound involving the use of a phonograph, a telephone and a graphophone.

Electric Clock Striking Mechanism, F. L. Gregory, Chicago, Ill., 520,184. Filed Apl. 27, 1893.

Uterus Battery, C. S. W. Hinkley, San Antonio, Tex., 520,206. Filed Apl. 10, 1894.

Electrolytic Cell, T. Craney, Bay City, Mich., 520,257. Filed Sept. 2, 1893.

Electrical Contact Mechanism. J. F. Blake, New Haven, Conn., 520,351. Filed Mch. 3, 1894.

Relates to mechanism for steam pressure gauges electrically connected with an alarm.

Railways and Appliances:—

Electrical Train Brake, W. C. Fletcher, St. Louis, Mo., 520,108. Filed July 28, 1892.

Claim 1 follows:

The combination of a generator of electricity; a circuit controlling the brakes; a switch on each car adapted to short-circuit the brake on said car, and a circuit which operates electro magnets connected to said switches to cut out said brakes successively.

Electric Locomotive, R. M. Hunter, Philadelphia, Pa., 520,111. Filed Apl. 25, 1893.

Relates especially to the method of mounting the motor upon the axle and certain other mechanical details of construction.

Electric Railway Trolley, T. M. Brown, Cleveland, O., 520,156. Filed Sept. 28, 1893.

Employs two parallel trolley poles with universal joint connections supporting a shorter vertical arm which carries the trolley.

Trolley Wire Hanger, T. J. McTighe and S. W. Childs, New York, 520,218. Filed Jan. 23, 1893.

Employs a U-shaped metal clip surrounding the wire and secured to the hammer, and a cotter adapted to be driven into the space between the wire and the hanger to bind them together.

Electric Locomotive, R. Eickemeyer, Yonkers, N. Y., 520,228. Filed June 1, 1891.

The invention consists of a waterproof and dustproof casing for the protection of the motor.

Electric Railway, E. W. von Siemens, Berlin, Germany, 520,274. Filed Sept. 30, 1892.

Claim 11 follows:

In an electric railway system, two overhead tubular conductors, each having a slot and a vehicle having traveling contacts extending from within the tubular conductors through the slots to the vehicle.

Conduit Electric Railway, W. R. De Voe, Shreveport, La., 520,304. Filed Jan. 20, 1894.

Relates more especially to the mechanical construction of the conduit and the collecting device.

Block System for Trolley Railways, W. F. Lewis, Swampscott, Mass., 520,323. Filed July 20, 1893.

Electric Traction Apparatus, P. Schoop, Zurich, Switzerland, 520,340. Filed Oct. 30, 1893.

The invention relates to the arrangement of an accumulator battery in combination with any ordinary railway generating apparatus for the purpose of economizing and providing for emergencies.

Conduit Electric Railway, C. W. Siemens, Dec'd., Guarantee Trust & Safe Deposit Co., Administrator, Philadelphia, Pa., 520,356. Filed Oct. 19, 1893.

Claim 3 follows:

In an electric railway system, a continuous underground chamber having hinged or removable covers giving access to said chambers, channel irons located at intervals within said chamber, and a conductor supported by said channel irons.

Switches and Cut-Outs:—

Switchboard for High Tension Circuits, J. J. Wood, Fort Wayne, Ind., 520,128. Filed Feb. 6, 1894.

Carbon Switch, F. Von Hefner-Alteneck, Berlin, Germany, 520,263. Filed Nov. 15, 1893.

A switch so constructed that when the resistance is cut into circuit by it a mechanism will automatically adjust itself in readiness for operation for regulating the resistance by separating the switch carbons more or less to control the length of arc between them.

Electric Switch, H. E. Werline, Lancaster, Pa., 520,279. Filed Feb. 15, 1893.

A rotary single pole switch for incandescent circuits.

Automatic Device for Removing Resistances in Starting Electric Motors and Replacing Same, G. H. Whittingham, Baltimore, Md., 520,280. Filed June 18, 1893.

Combined Cut-Out and Cord Adjuster, E. D. Knap, Schenectady, N. Y., 520,318. Filed Nov. 25, 1893.

Overhead Trolley Conductor, R. Muir, Brooklyn, N. Y., 520,329. Filed Mch. 8, 1894.

A conductor having a cross section substantially in the shape of an inverted U the inner and outer faces of which are insulated from one another.

Multiple Electric Fuse Box, E. A. Pearson, Ottawa, Can., 520,378. Filed Jan. 16, 1894.

Telephones and Apparatus:—

Telephone Trunk Line System, J. I. Sabin and W. Hampton, San Francisco, Cal., 520,083. Filed Feb. 12, 1894.

Employs an operator's telephone apparatus terminating in a switch socket whereby the operators circuit may be cut in by the insertion of the subscriber's plug.

Telephone, H. F. Slocum, New York, 520,086 Filed May 20, 1893.

Employs a diaphragm for the transmitter having a voltaic battery electrically connected with the telephone circuit, arranged within the diaphragm so that the internal resistance of the battery will be changed by the changes of form due to the vibration of the diaphragm.

Automatic Telephone System, L. E. Simoneau, Montreal, Can., 520,246. Filed July 11, 1893.

The invention consists in automatic release for returning to their normal position the operating parts of the system at the central office in a telephone system operated without the services of an attendant at the exchange.

Telephone Transmitter, H. M. & J. Goodman, Louisville, Ky., 520,306. Filed Jan. 25, 1894.

Employs two magnets at right angles to each other, their opposite poles being approximated, a mass of comminuted magnetic material between the magnet and a diaphragm magnetically connected with one of the magnets.

MAGNETIZATION OF RAILROAD TRACKS.

RECENT experiments in France, it is claimed, show interesting facts concerning the magnetization of rails and the effect of the direction of travel upon their polarity. Experiments upon a piece of track between Bordeaux and Cette, which extends in an east and west direction, show that the north pole is at the end of the rail that is the direction of travel. Where the road was double tracked, it was found that the polarity of the rails differed in the two tracks, and that the north end was invariably in the direction that the trains moved. This condition is supposed to be due to the shocks of trains in coming upon the rails, which give the end receiving the shock a south polarity. The shocks are due to relative elevations and depressions of the ends of abutting rails and to the spaces always left for expansion of the metal. The report does not explain why these concussions should develop a south polarity rather than a north polarity. Perhaps some of our readers may be able to give an explanation, provided the facts are as stated.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

WESTON ENGINES.

The Weston Engine Co., of Painted Post, N. Y., has just issued a beautifully printed and bound catalogue displaying some of the very best workmanship of Messrs. Bartlett & Co., both in the well executed illustrations and the artistic design and embossing of the cover. Aside from its pleasing appearance, however, the brochure is both valuable and interesting for its contents,—a well written, concise description of the Weston automatic engine, which in its new form has been on the market for over three years and in that time has established itself thoroughly as an engine of the highest class. The company's course in refitting their shop elaborately with expensive special machinery in anticipation of a heavy demand for these engines has been demonstrated a wise one. Sales have gradually increased until the shop capacity is again inadequate and extensive additions are being made to the tool equipment and floor space. That this growth is a substantial one there seems to be no doubt, for all engines turned out are said to be giving unquestionable satisfaction, as indicated by reports from owners.

The Weston engine is especially adapted to dynamo and generator driving for electric lighting and street railway work, where close regulation and high efficiency are of such importance. These engines are built for connecting direct to dynamos and generators by extending the crank shaft on one side to receive the armature and by using a specially designed sub-base to suit the requirements of any of the leading dynamos manufactured. They are the heaviest of their type on the market, and are also very compact, and at the same time every adjustable part is easily accessible. Every wearing part has provision for adjustment, so that with proper attention from the engineer there can be no noise in running. All the details are constructed in the best manner on accurate machinery by skilled mechanics. Hardened steel is used wherever advisable and every nut is case-hardened. The bed is made especially heavy, having interior ribs running cross and lengthwise in sufficient number to make it absolutely rigid and proof against any springing tendency. The main bearings are of the quarter-box type with an adjustable cheek piece to take up wear, and a cap made adjustable with babbitt liners. The guides constitute a fixed portion of bed, planed therein and accurately scraped. The cross-head is adjustable to accommodate any wear and is so constructed that the piston rod after being fastened to it can never get loose by accident. The reciprocating parts are balanced entirely in the crank discs, the wheels being balanced independently. The cylinder and steam chest are in one casting made from the best charcoal iron, and a cast-iron jacket allows the cylinder to be covered on the outside with mineral wool for the prevention of condensation. The piston is made hollow and grooved for cast-iron packing rings. It is shrunk on the rod and otherwise effectively locked. The crank shaft and crank pin are made in one piece from the best quality of steel, and are provided with detachable counterbalancing discs. No built-up cranks are used. Interchangeability of parts of these engines forms a valuable feature, as break-downs will sometimes occur in the best regulated engine rooms, and if repairs will fit accurately, much expense and annoyance is avoided.

This general description will give one an idea of some of the points of this excellent engine. The catalogue goes further and takes up each section in detail. It will be found useful by all interested in the use of steam.

ELECTRIC APPLIANCE CO.

THE requirements of the fire underwriters in the majority of the large cities have recently been made to call for globe nets over all arc lamp globes to prevent the globes from falling to pieces when broken on the lamp. The Electric Appliance Company are furnishing a special globe net for this work in different sizes, and are meeting with as much success in their sale as they have had with the Acme expanding wire guard for protecting incandescent lamps. The adaptibility of the Packard Mogul lamp for large interior lighting and also for outdoor lighting under special conditions is becoming more apparent as the lamp becomes more extensively introduced, and the company have also sold during the past week a number of complete Mogul lamp equipments for theatre and hall lighting in addition to two or three outfits for outside work as a substitute for arc lamps.

THE CONSOLIDATED ELECTRIC CO. of Schuylerville, Greenwich and Cambridge, N. Y., has extended its lines to Victory Mills and is now lighting that village with twelve arc lamps. The company is talking of extending its lines to Salem, N. Y., a distance of seventeen miles from the power station.

MAY'S REVOLUTION COUNTER.

This handy little instrument, illustrated in the accompanying engravings, shows the number of revolutions of a shaft by means of two hands traversing a dial similar to that of a watch. The longer hand indicates the units and tens of revolution and the smaller the hundreds. In order to make error in reading impossible whether the shaft be running in one direction or the other, a neat device has been introduced. This consists in placing the dial plate carrying the numbers under a perforated plate, the numbers on the dial showing through the perforations. There are two sets of numbers on the dial plate, one set reading from right to left and the other from left to right, as shown in Figs. 1 and 2. Should the shaft move from right to left the figures on the dial move automatically so as to come under the perforations as shown in Fig. 1, while if the shaft move in the other direction, the other set of figures show through the perforations. After reading the number of revolutions the hands can be quickly brought to zero by opening the case and turning a small knob.

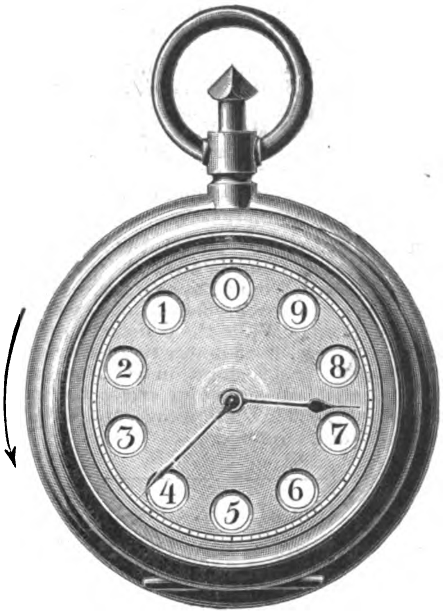


Fig. 1.—May's Revolution Counter.

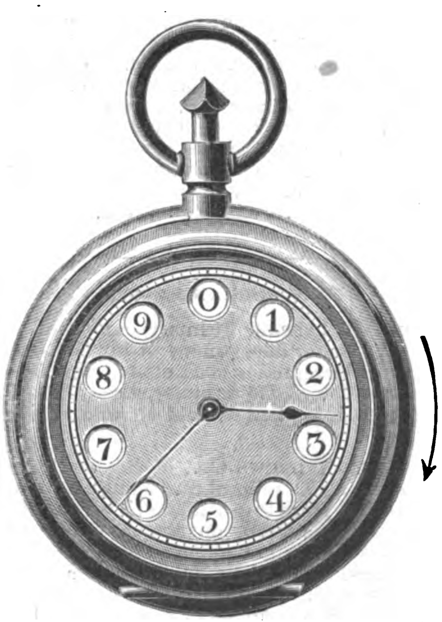
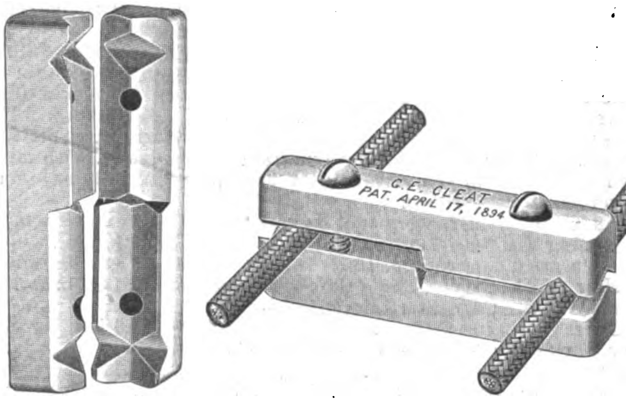


Fig. 2.—May's Revolution Counter.

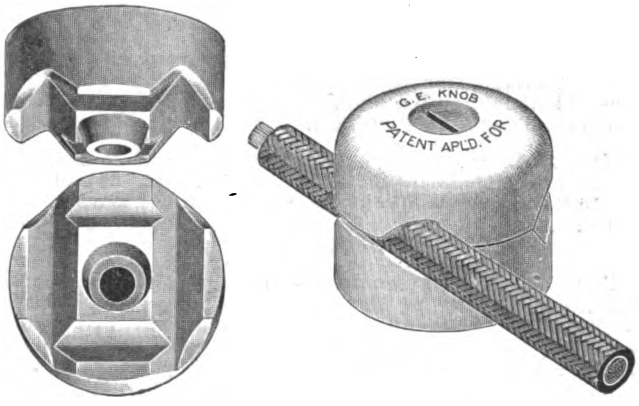
The spindle of the revolution counter is protected by the watch ring so that the instrument can be carried in the pocket just like a watch, without injuring the clothing. The advantages of the instrument are its great portability, its simplicity of operation in virtue of which it can be placed in the hands of any one without requiring any special instructions for its use. This little device is manufactured by Dr. Oscar May, of Frankfurt a. M., Germany, and has met with considerable success abroad.

NEW GENERAL ELECTRIC WIRING APPLIANCES.

The General Electric Company have lately designed certain new porcelain wiring appliances to meet the insurance requirements. The cleat, Figs. 1 and 2, is formed of two pieces exactly alike, in which the groove is so shaped that it will take a wire up to 5/16 inch in diameter, and the wires are 2½ inches apart, as specified in the insurance rules. The knob, Figs. 3 and 4, is designed to hold wires from 3/16 to ½ inch, and to do away with the unsightly tie wire. The top and bottom are each provided with four grooves of different dimensions so that any wires within the range given may be secured. This knob is 1½ inches high and 2 inches in diameter. the wire being held ½ inch from the ceiling. The floor and window tube, Fig. 5, has a central hole ⅝ inch in diameter and a head 2¼ inches in diameter. It is 1⅜ inches outside diameter and 3¾ long. These porcelain appliances, like all the others made by the General Electric Co., are of the best hard white vitrified non-absorbent porcelain of the highest resistance.



Figs. 1 and 2.



Figs. 3 and 4.

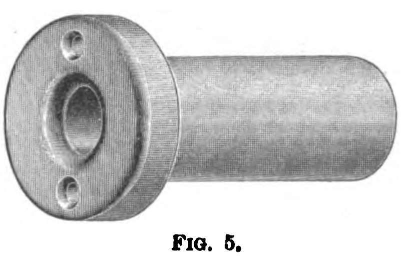


Fig. 5.

The Hudson River Telephone Co., will build over the old line between Saratoga Springs, Schuylerville and Greenwich, N. Y., making a metallic circuit from each place.

THE CARPENTER ENAMEL RHEOSTAT CO.—A NEW FACTORY AND NEW PRICES.

The Carpenter Enamel Rheostat Company is moving its factory from Bridgeport, Conn., to Hoboken, N. J., in the new factory building erected by John C. Crevier, at the 14th St. Ferry terminal. This company is continually improving the design and construction of its apparatus, and, on account of its rapidly increasing business and improvements in methods of manufacture, is making a great decrease in the cost of production, the benefit of which it is giving to its customers by very marked reductions in the prices.

A sweeping reduction in the cost of the standard rheostats is announced this week, the reductions running as high as 45 per cent. in some instances. This great reduction in the prices of these rheostats, which were already very reasonable in cost, ought to make them even more popular than heretofore with manufacturers of generators and motors, and with contractors. The Carpenter Company have just issued three very attractive blotters giving illustrations of their various standard rheostats, with tabulated statements of the various data and prices, which are very convenient for reference.

The Company's factory will be very accessible in its new location, being less than 15 minutes distant from Union Square, which will be a great convenience to its various customers having offices in New York City. The following is a list of the principal agencies of the Carpenter Company :—

Chas. D. Shain, General Selling Agent, No. 186 Liberty St., New York City; The Central Electric Company, No. 178 Adams St., Chicago, Ill.; Walker & Kepler, No. 531 Chestnut St., Philadelphia, Pa.; William Oswald, No. 42 Union St., New Orleans, La.; R. C. Wiggins. No. 31 Milk St., Boston, Mass.; The Robins Electric Co., No. 830 Liberty Ave., Pittsburgh, Pa.; Owen Ford, Rialto Building, St. Louis, Mo. The officers of the company are: H. Ward Leonard, President; L. B. Gawtry, Vice-president; Charles E. Carpenter, Secretary and Treasurer.

WESTERN NOTES.

Mr. Chas. F. Foster, late Mechanical Engineer of the World's Columbian Exposition announces that he has opened an office at 1411–1412 Manhattan Building, Chicago, and is prepared to carry on a general engneering business.

Kohler Bros., Chicago, have arranged to move their offices to the more commodious suite of rooms Nos. 1644, 1645, 1646, 1647 and 1648 Monadnock Block. In addition to the agency of the Walker Mfg. Co., they will as heretofore handle the Western business of the Eddy Electric Mfg. Co.

The Elkhart Transformer.—To judge from some testimonial letters exhibited by Mr. Hornberger last week, the Elkhart transformer is constantly growing in popularity. The company have lately been making some slight changes in the construction, making the efficiency and regulation of their apparatus still higher.

The Electric Appliance Company of Chicago report that the demand for their Allen soldering stick has become so general that "Babies cry for it." In fact the demand that has been created in a very short time for this specialty is certainly surprising, for notwithstanding the fact that it has been introduced only a few months, it is now said to be in general use by nearly every station and construction man in the country with very satisfactory results. The company are also pleased with the success of their experiment of carrying an exceptionally large stock of Packard lamps in Chicago. Their sales during the past month have been more than satisfactory to the manufacturers as well as themselves, particularly in view of the fact that the season for large lamp business is generally considered to have gone by some months ago.

The Trolley Situation in Chicago is gradually crystallizing into definite shape and the prospects for rapid transit on the North and West sides are very good. At a recent City Council meeting ordinances allowing the construction of electric lines on Fullerton and Armitage avenues were passed. A proposed amendment making letter carriers free passengers was tabled. The omnibus ordinance allowing the Chicago City Railway Company to transform its horse car lines into overhead trolley lines is still before the committee on streets and alleys south. It is said that it will remain there for some time before another attempt to get it through the council is made. The Northern Electric Railway has asked for a twenty year franchise on the following streets: West Forty-seventh, West Forty-eighth, Jefferson Ave., North avenue, Central avenue, Leyden avenue, Belden avenue and Poland avenue. The cars are to be propelled by overhead contact wires strung on poles in the centre of the street, the city having the right to string its own wires thereon. A metallic return circuit is also provided. Storage batteries may be used. An annual license fee of $50 per car is provided for. The ordinance has been sent to the committee on streets and alleys west.

The City of Hawarden, Ia., is to put in a 1,000 light incandescent municipal plant, and has adopted plans and specifications prepared by Wm. H. Bryan, consulting engineer, St. Louis. The city is prepared to pay cash.

Messrs. Lincoln & Co., Chicago, report that they have recently added some important specialties to their lines such as the Wagner direct and alternating motors, Sunbeam lamps and the Crouse & Tremaine carbons and carbon brushes.

Capt. Willard L. Candee and Mr. Hodges, of the Okonite Co., were in Chicago last week calling on their numerous friends and customers. They spent considerable time inspecting and admiring the largest electrical supply house in the world.

The Washington Electric Co., Chicago, has recently moved to numbers 205 to 207 South Canal St., a few doors from the former location. The company has recently been reorganized, Mr. Louis Stein retiring. Mr. W. O. Meissner is now president and Mr. Merrill Watson, secretary. Mr. Meissner reports several important orders for their celebrated focussing lamps, and considers the outlook for better business in their line as very encouraging.

The Central Electic Co., 172–175 Adams street, Chicago, are making an installation in their own building of the metal sheathed Interior Conduit. It will, from all appearances, afford an excellent example of what may be accomplished in the way of wiring after a building is completed. While the polished metal covering adds somewhat to the expense, it undoubtedly increases the artistic and workmanship effect. No discoloration of the walls or ceilings or accumulations of dust occur when wires are incased in these tubes. The Central Electric Co. are the general Western agents for the Interior Conduit supplies.

NEW YORK NOTES.

The Abendroth & Root Mfg. Co., 28 Cliff St., have just issued "Information Pamphlet, No. 3," a brochure elegantly printed by the Bartlett press, and comprising nearly 100 pithy and interesting discussion of points in boiler construction and use. The method of treating the matter is very ingenious and attractive. A number of claims are advanced as to the reasons for the superiority and high efficiency of the Improved Root water tube boiler, and then the conditions involved in each claim are argued out with a surprising amount of directness, cogency and detail. The interest never flags, and the whole subject is presented in a manner that any intelligent man can follow. This gift of exposition is rare. The pamphlet is entitled: "A Few Plain Facts Concerning Water Tube Boilers," and as a copy can be secured by asking for it, we recommend all our readers to add this book to their working libraries by application for it to the firm.

The General Electric Company reports the following orders for railway apparatus taken during the past week from the New York office alone: Brooklyn, Queens County & Suburban Co., 450 motors; Bridgeport (Conn.) Traction Co., 60 motors and generators; Danbury (Conn.) Street Railway Co., 20 motors; New Haven (Conn.) Street Railway Co., 20 motors and generators; Hart (Conn.) Street Railway Co., 8 motors; Allegheny Traction Co., Pittsburgh, Pa., 30 motors and generators; Jacob Rich. San José Co., two equipments and generators; W. B. Ferguson, Boston, one generator; Franklin, Pa., 6 motors; Electric Traction Co., and People's Traction Co., Philadelphia, Pa., large marble switchboards.

NEW ENGLAND NOTES.

Mr. Arthur W. Tappan, formerly connected as expert and salesman with the meter department of the General Electric Co., in Boston, has now accepted a position as salesman with Messrs. Wm. L. Walker & Co., of 178 Summer street, Boston, a firm who have recently gone into the business of second-hand electric apparatus.

The Pettingell-Andrews Co., of Boston, have moved into their new quarters at 72 Federal St., though at this writing they have not yet got the store into satisfactory condition. They are at present erecting a staging on which they will display the heavier Lundell motors and generators, and in about a week's time will doubtless have their new quarters looking neat and orderly. The site of the store is perhaps the best that could have been chosen, and when completed the store will present a very handsome and attractive appearance.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.

Vol. XVII. JUNE 6, 1894. No. 318.

ELECTRIC LIGHTING, HEATING AND POWER PLANT OF THE NEW BOSTON & MAINE AND FITCHBURG RAILROAD UNION STATION, BOSTON.

BY

A. C. Shaw.

I.—INTRODUCTORY.

ABOUT a year ago when it was decided that Boston should have a grand union depot to accommodate the Eastern, Western and Southern divisions of the Boston & Maine Railroad, and the Fitchburg Railroad, it became necessary to erect a very large building with extensive train sheds, the lighting of which at once became a serious problem. The train sheds are 480 feet long from the gates to the outer end, by 450 feet wide, and the buildings for the waiting rooms, ticket offices, company offices, etc., are about 200 feet deep by about 450 feet wide. It was at once seen that this involved a very large amount of lighting, and it was early determined to erect a central station for that purpose, which would also be used for furnishing steam for heating the buildings, and electric power for operating turn-tables, drawbridges, coal handling machinery and elevators in the adjoining freight sheds and waiting rooms. It was calculated that it would require about 2,000 16 c. p. lights and 150 arc lights for the Causeway street station, but as it was intended to light the whole terminal including the freight sheds on the other side of the river as far as East Somerville, provision was made for an additional 2,000 incandescent lamps and 50 arc lights, and also 300 horse power for electric motors, and 100 horse power for varied elevator service. It became at once apparent, therefore, that an electric plant of large capacity was necessary, and the station, now completed, which is described in this article, has a capacity, reckoned on the basis of 16 candle power incandescent lamps, of 12,000 lamps, or about 1,100 horse power. Specifications and preliminary plans were prepared by Mr. George H. Barrus, the well-known steam expert, who was retained by the Boston & Maine Railroad as consulting engineer and after competitive designs were submitted by various companies on the basis of these specifications, the contract for building and installing this plant was awarded to Messrs. Westinghouse, Church, Kerr & Co., who have installed a model plant, the prominent features of which are the Westinghouse Kodaks, and a complete system of economizers and mechanical draft.

The entire plant has been installed in duplicate, with a relay for each running unit, so that even when the full amount of current is being drawn from the plant, one-half of the units are idle, and ready to be thrown into service at a moment's notice, thereby eliminating any danger of the plant failing to supply current at all times. This is rendered necessary by the extremely exacting requirements of a large railway terminus, which is open day and night every day in the year. The plant has been designed also so that additional units can be added at any time in case the capacity should increase and encroach upon the relay reserve.

II.—THE POWER HOUSE.

The power house is situated on Minot street, at the outer end of the train sheds, and is 125 feet long by 87 feet wide by about 30 feet high. The building is of plain brick construction, the walls resting on about 6 feet of granite on top of a pile foundation. In the engine room, on top of the earth filling, is a bed of concrete 2½ feet thick, extending over the whole area, on which are built the brick foundations for the engines and generators, 21′ long x 8′ 6″ wide at the bottom, and 19′ long x 6′ 6″ at the top. In the boiler room the concrete also extends over the whole area, and no foundations are necessary, the boiler setting resting directly on the concrete. The engine room roof rests on five iron trusses 6 feet deep at the outside wall, and 4 feet deep at the inside wall between the engine and boiler rooms, and is composed of 2″ hard pine covered with tar and gravel. In the centre is a capacious monitor extending nearly the entire length of the building, giving ample ventilation and light. The boiler room roof is supported on six iron trusses, five feet deep in the centre and four feet deep at the ends, so that it has a double pitch, and is also provided with an ample monitor.

III.—THE ENGINE ROOM.

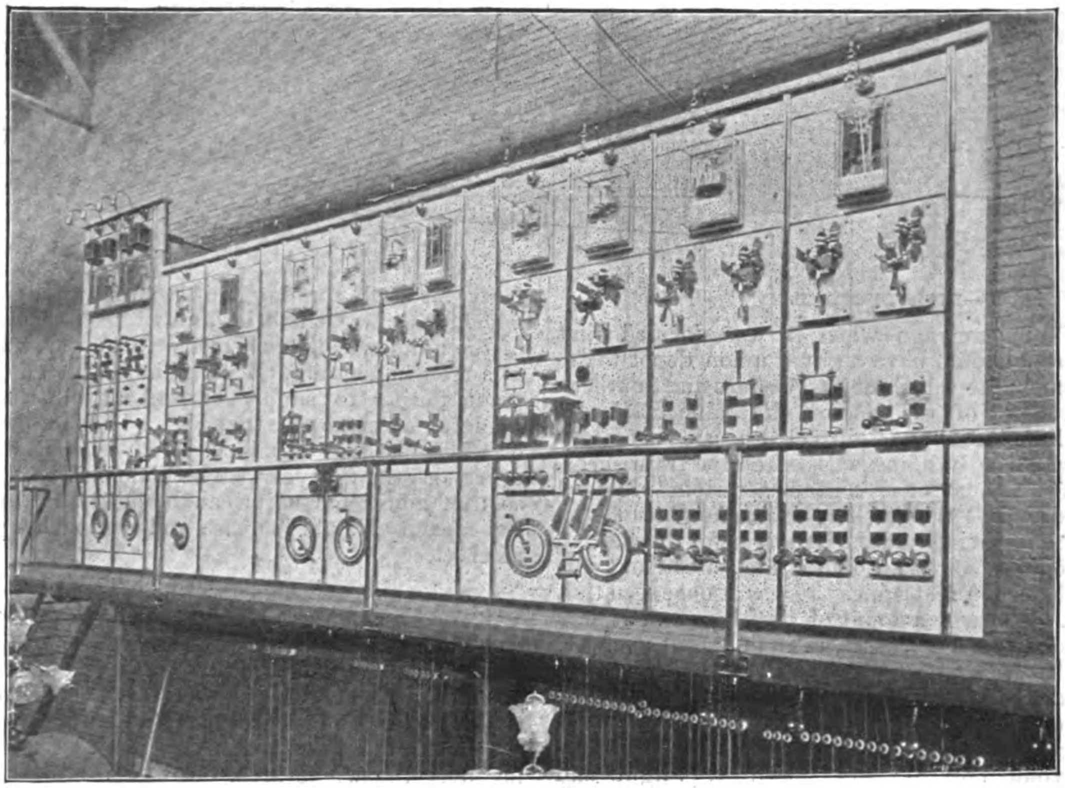
The engine room is 90 feet long by 34 feet wide, and contains four Westinghouse direct connected Kodak engines and generators, two being 125 volts and 125 kilowatts, and two being 500 volts and 125 kilowatts. Each engine is compound condensing, and is of the latest Westinghouse type, having cylinders 14″ and 24″ diam. by 14″

stroke. The 125 volt generators are used for the lighting in the depot only, and the 500 volt generators for the various power circuits. In addition there is another compound condensing Westinghouse engine of the same size belted to a 2,200 light Westinghouse alternating dynamo, for furnishing current for distant lighting, and an 11" x 19" x 11" compound condensing Westinghouse engine belted to an 1,100 light Westinghouse alternating dynamo for the same purpose. These alternators are of the latest Westinghouse slow-speed type, designed for 7,200 alternations per minute, and operate at 2,000 volts, the larger machines running at only 600 revolutions, and the smaller at 720 revolutions per minute. Driven from the governor pulley of one of the Kodak engines is a 62 kilowatt General Electric generator of 220 volts, for furnishing current for two elevators already in service.

At one end of the engine room is a 15 horse power standard Westinghouse engine direct coupled to a 7½ kilowatt Billberg 75 volt generator for charging the storage batteries used for operating the electro pneumatic switches in service at this terminal, and which were installed by the Union Switch & Signal Co. of Pittsburgh, Pa. The batteries which are of the Sorley type, manufactured by the Eastern Electric Storage Battery Co., of Lowell, Mass., are situated in the switch towers about half a mile away.

Steam is conveyed from the boiler room by four 8" feeders, connected by long copper bends to an 8" header, which runs the entire length of the space covered by the engines. From this header 6" inch long-turn copper bends lead to the Westinghouse separators situated on top of the engines, from which the steam passes to the engines. The entire high pressure system is made of extra heavy wrought iron pipe, the fittings also being of extra heavy pattern, the joints being tongued and grooved and packed with corrugated copper gaskets. By an ingeniously worked out plan any portion of the piping can be removed and repaired without shutting down the plant, and the advantages of a duplicate system of piping are obtained without the introduction of the complication and cost of duplicate piping. Ludlow valves manufactured by the Ludlow Manufacturing Co., of Troy, N. Y., are used throughout. The exhaust from the engines is conveyed through an 8" pipe which runs from the engines to the condensers, which are of the Bulkley injector type, manufactured by Henry W. Bulkley, of New York, and which are placed vertically against the wall between the engine and boiler rooms, and extend through the roof, where the steam mingles with the injection water. Sea water is used for condensing and is supplied to the condensers by two 14" x 18" Bulkley pumps.

In one corner of the engine room is a handsome marble gauge board fitted with Crosby steam gauges for high and low pressure, vacuum gauges, water gauges for showing the height of the water in the boilers, and a draft gauge for showing the amount of mechanical draft produced by the fans.

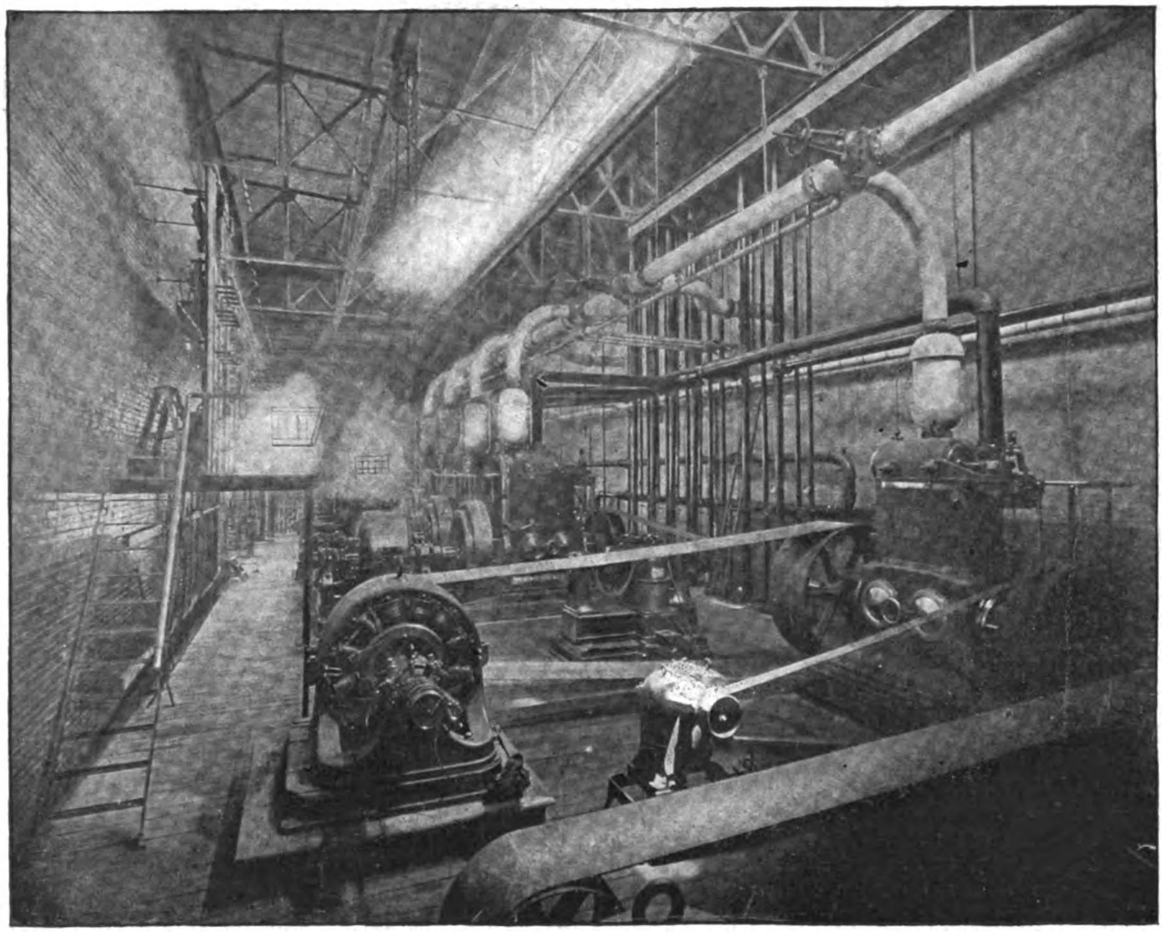


MAIN SWITCHBOARD, NEW BOSTON & MAINE RAILROAD STATION.

IV.—THE SWITCHBOARD.

The switchboard, which is a very handsome and substantial structure, is situated on a gallery 8 feet above the engine room floor, and is 6 feet wide by 32 feet long. It consists of white marble panels supported on a wrought iron frame and is absolutely fireproof. The 125 volt board consists of two generator panels each having a field rheostat, a triple pole 1,000 ampere switch, receptacle for Weston voltmeter, circuit breakers in case of overload, and an ammeter reading up to 1,000 amperes. Two feeder panels are also provided for the 125 volt circuits, containing four triple pole 300 ampere switches (for throwing the system on to the Edison Illuminating Company's street circuits if required), four 600 ampere double pole switches controlling four feeders, four circuit breakers, one 2,000 ampere ammeter and one 125 volt voltmeter. Adjoining these panels is the 500 volt board consisting of two generator panels, each containing field rheostat, receptacle for voltmeter, triple pole switch, automatic circuit breaker and a 300 ampere ammeter. The feeder panel of this board contains two quick-break feeder switches, two circuit breakers, one 600 ampere ammeter and one 600 volt voltmeter.

Next in order is the 220 volt board consisting of one generator panel, containing field rheostat, double-pole double-throw switch (for using the Edison street service) one circuit breaker and one ammeter, and a feeder panel containing two quick break switches, two circuit breakers, and a voltmeter. Lastly, comes the alternating switchboard consisting of two panels, on each of which are mounted two rheostats, above which are the plug switches for the machine and feeder circuits, the board being arranged so that any circuit can be put on either machine at will without danger of being short circuited. On each panel are two lightning arresters, of the new Wurts type, voltmeter and ammeter, and four transformers, two of which are used for ground detectors and two for lighting the board. The whole switchboard is about 28 feet long by 8 feet 6 inches high, except the alternating board which is ten feet high, and stands three feet from the wall. All the wiring is on the back of the board, and the whole presents a very handsome and attractive appearance.



ENGINE AND BOILER ROOM, NEW BOSTON & MAINE RAILROAD STATION.

V.—THE BOILER ROOM.

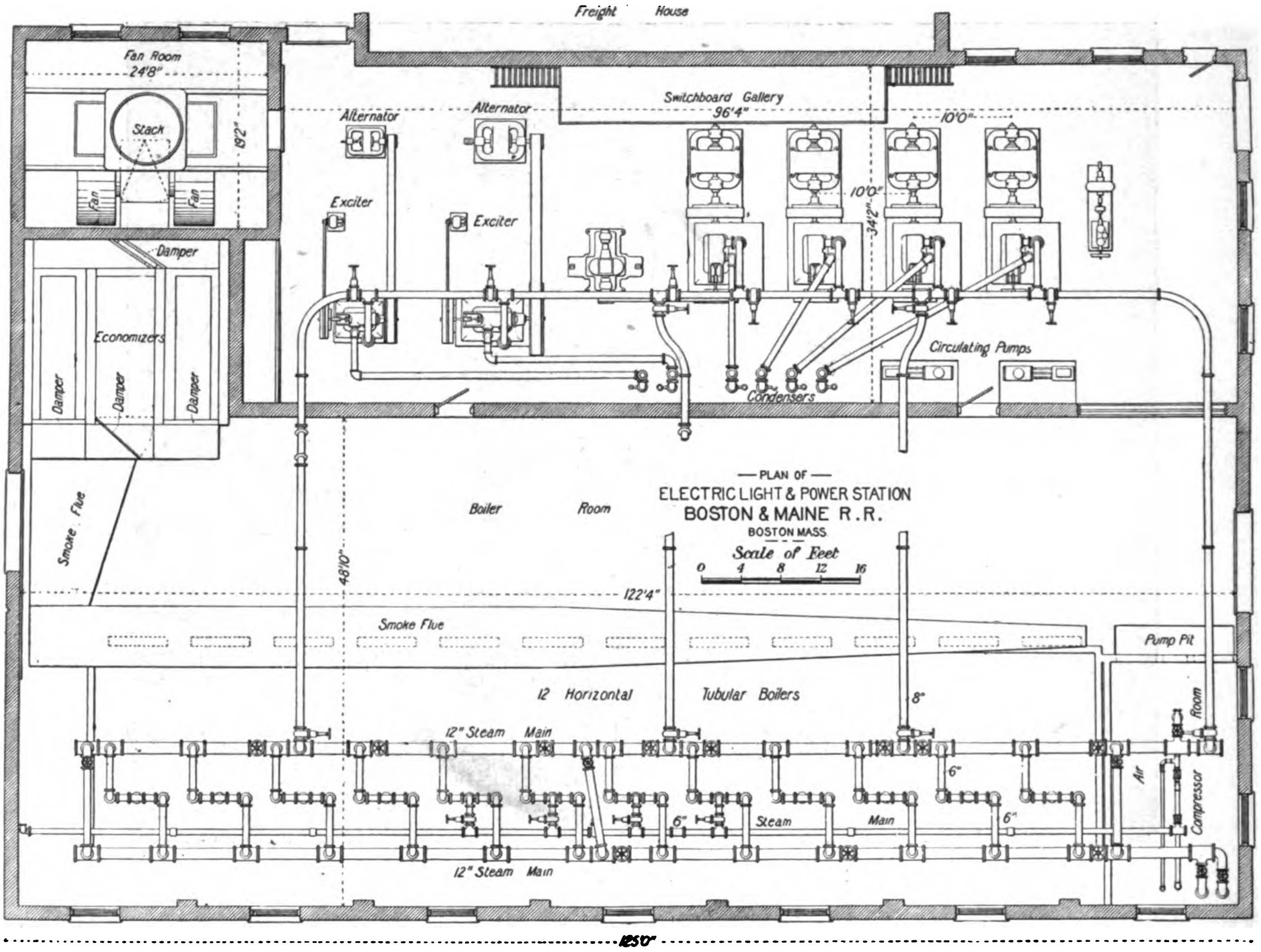
The boiler room is 122 feet long by 49 feet wide, and contains 12 horizontal tubular boilers each 72″ in diameter by 17′ 6″ long, with 130 three inch tubes 17 feet long, manufactured by the Swamscot Machine Co., of South Newmarket, N. H., and provided with Jones economic furnaces to aid combustion, made by S. P. Jones, of Boston, Six of these boilers are for heating the railway station buildings, and work at a pressure of 80 pounds, reducing valves being placed in the buildings. The remaining six are used for producing the steam for the engines, are made of heavier material, with butt strap joints, and work at 125 pounds pressure. On top of the boilers are two 12″ mains running the entire length of the battery, the front main being used for the high pressure steam, and connected to the four feeders which supply the engines. The back main is used for the low pressure steam for heating, and two 8″ pipes are connected to it for supplying the station buildings in winter, and also a 4″ pipe for summer use for the restaurant and barber shop. These pipes pass under the street and buildings in a conduit about 1,200 feet long, and the condensed water is trapped into a 6″ main and returned to the hot well in the boiler room. Both mains are connected to all twelve boilers, and to each other by three cross-overs, and each main is provided with 12″ Ludlow valves at intervals, so that either main can be used for high pressure purposes when required, and sections of each can be removed for possible repairs, without interfering with the operation of the plant. In addition to the 12″ mains, there is also a 6″ main running the entire length of the battery connected to the four middle boilers, two low pressure and two high pressure, from which either high or low pressure steam may be had to operate the four engines, feed pumps, injectors, &c. At one end of the boiler room are two 14″ x 18″ Ingersoll-Sargent Rock Drill Co.'s compressors for furnishing the compressed air to operate the electro-pneumatic switches. The smoke flue is 2 feet by 3 feet at the first boiler and increases to its full size over the sixth boiler where it measures 10 feet by 6 feet, and where also it becomes a double flue, the upper half being for the smoke from the low pressure boilers, and the lower half for the high pressure boilers. Each half of the flue is provided with a Locke steam damper regulator situated on the side wall of the twelfth boiler. The flue after passing the twelfth boiler is extended across the fire room into a chamber in front of the economizers used for heating the feed water. The economizers, of which there is a pair, are of the Greene type, as modified by Westinghouse, Church, Kerr & Co., the by-pass and dampers being so arranged that the gases can pass through either economizer alone, through both together (in multiple), or through first one and then the other (in series) so that the utmost advantage may be taken of the gases passing for the best heating effect under varying conditions. The scrapers of the economizers are driven by a belt from the shaft of the fan engine. From the economizers the smoke passes into a breeching between two 11-foot exhaust fans driven by independent vertical 5 h. p. engines, either one of which is adequate for the full capacity of the plant, a damper being provided so that either or both fans may be used. From the fans the gases pass directly into the smoke stack which is set directly on top of the fans and rests on I beams. The stack is 7′ 0″ in diameter and 35 feet high, the lower courses being made of $\frac{3}{8}''$ iron and the upper courses of $\frac{1}{4}''$ iron.

The condensation in the steam mains in the engine room is caught by the separators and is returned to the boilers by the Westinghouse, Church, Kerr steam loop, ending in a header on the side wall of the twelfth boiler, and all the mains in the boiler room are drained by the gravity system, the drips being arranged so that if a section of the main be changed from low to high pressure, the condensation may be returned to the proper boiler. Steam loops are also applied to protect the fan engines and there are also supplementary loops provided at various points in the main headers to take care of any entrained water which may be carried over.

For feeding the boilers there is provided a No. 14 Korting injector, capable of handling 4,500 gallons of water per hour, and two feed pumps located in the pit under the air compressors, one being a No. 7 Knowles feed pump, and the other a Knowles fire pump 14″ x 7″ x 12″, which, in addition to feeding the boilers, is provided with an independent connection to the street for fire purposes. The condensed water is all drained into a tank 6 feet in diameter by 6 feet deep, situated in one corner of the boiler room, and this hot water is returned to the boilers through the economizers previously described, the piping being so arranged, that the water can be passed through the pair of economizers, either singly, in multiple or in series, as the conditions may determine.

VI.—OUTSIDE CONSTRUCTION.

Owing to the distance of the central station from the centre of lighting, about 1,200 feet, and the large number of lights, considerable outside construction has been necessary. There are about 1,000 incandescent lamps in the new office buildings and waiting rooms, and about 900 incandescent lamps in the old portion of the Lowell depot, besides 130 arc lights on incandescent circuits in the train sheds. The current is conveyed to the centre of distribution for lighting purposes by three feeders, one of which is composed of four cables (two positive and two negative) each of 1,500,000 circular mils, one of four cables 400,000 circular mils, and one for the arc lights only, of four cables 850,000 circular mils. The largest cable used is 2,790,000 circular mils, which is probably the largest single cable in the country. In addition there is a 0000 B. & S. circuit of 220 volts for current for operating the motor service and elevators. The arc lights used in the train shed are all of the Waterhouse, Gamble & Co. type, manufactured by the Perkins Electric Switch Manufacturing Co., of Hart-



DYNAMO, ENGINE AND BOILER ROOM OF THE BOSTON & MAINE AND FITCHBURG RAILROAD UNION STATION.—PLAN.

ford, Conn., and are arranged to burn two in series. The cables were all manufactured by the Washburn & Moen Manufacturing Co., of Worcester, Mass., and are double rubber covered, heavily taped and then protected by two heavy braids. They are of the "Crown" brand, made of stranded copper, and are extremely handsome, of high insulation, and of thoroughly substantial and durable appearance. The cables are laid underground across the street in a brick conduit 4½ feet high by 3½ feet wide, supported by porcelains on the side wall. In the train sheds they are suspended by porcelain insulators underneath the baggage room floor. The alternating current and the 500 volt current will be conveyed across the river by three cables having twin conductors No. 2 B. & S. gauge, specially made of very high insulation by Washburn & Moen for this work. The two conductors each have three insulations of rubber, the one next the copper being absolutely pure unvulcanized rubber, and are then twisted together, sewed with a heavy jute, armored and cotton covered over all. The 500-volt circuit will be used to operate coal handling apparatus, drawbridges and turn tables, and the alternating circuits for lighting the freight sheds, shops and yards as far as Mystic Wharf, nearly 3 miles distant.

VII.—CONCLUSION.

The entire plant is now in daily service, operating 24 hours a day, has given entire satisfaction and reflects great credit, as a model piece of electrical engineering in station construction, on Messrs. Westinghouse, Church, Kerr & Co., who not only prepared the principal designs but carried out the work of construction from the first. Much of the success of the plant is also due to the untiring energy of Mr. Bissell, chief engineer, and Mr. Frederick D. Hall, electrician, of the B. & M. Railroad, whose careful attention to the details and designs of the plant, and extensive outside construction, have ensured to them an electric plant of the very highest character and second to none in point of compactness and excellence in the country.

LIGHTING BY RESONANCE.

In describing Dr. Pupin's system of "resonating conductors" and its application to telegraphy and telephony in our issue of May 23, reference was made to the fact that Dr. Pupin also contemplated the utilization of this method for the production of light. As a matter of fact Dr. Pupin has for some time past devoted his attention to this subject and has progressed sufficiently to encourage him in the belief that at no distant time practical results will be obtained. At the invitation of Dr. Pupin a small party of gentlemen gathered at Columbia College on the evening of May 30, to witness some experiments on the production of light by resonance effects.

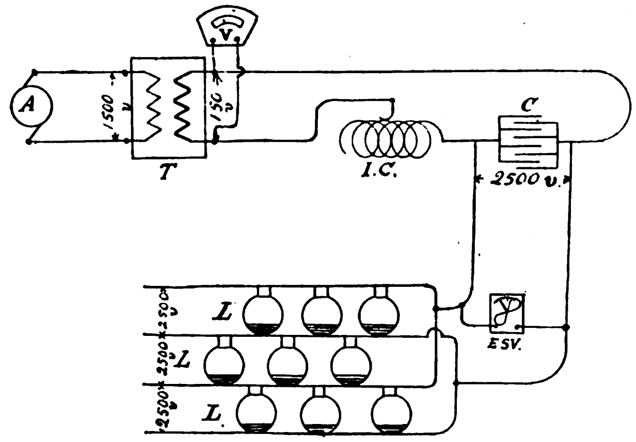
Before passing to the description of these experiments it may be well to point out briefly that Dr. Pupin has started out with the object of obtaining light effects at low frequencies and comparatively low potentials having in view the utilization of existing alternating circuits. By creating resonance effects Dr. Pupin increases the potential at the lamp terminals so as to produce luminous effects in vacuum tubes.

The experiments showed how it was a simple matter to operate practically any number of vacuum tubes or lamps in parallel and for that purpose Dr. Pupin employed 100 Edison 100 C. P. lamps. These were used merely for convenience, as a sufficient number of vacuum tubes without filaments was not available. From what follows it is evident that the filaments played no part in the phenomena of light production.

The arrangement of the apparatus employed is shown diagramatically in the accompanying engraving. A 1,500-volt Slattery alternator, A, of the usual type giving 130 cycles per second furnished current for a transformer, T, which reduced the pressure to 150 volts at the secondary terminals. In series with the secondary were two inductance coils indicated at I C, one of which could be regulated by throwing sections of the coil in or out. Included in the circuit, also in series, were two condensers C of ½ microfarad each.

The lamps L were connected as a shunt to the condensers, as shown and arranged in three rows of 33 each, all being connected in parallel across the circuit. Each lamp (100 C. P., Edison) was connected to one side of the circuit by the metal base and connection to the other side of the circuit was effected through the medium of a tin foil coating at the bottom of the globe which covered about one-sixth of the surface of the lamp. A Weston voltmeter V measured the potential at the terminals of the transformer secondary and an electrostatic voltmeter E S V measured the potential at the lamp terminals.

The alternator being started, the circuit was tuned by means of the adjustable inductance coil, the potential at the lamps gradually increasing up to 2,500 volts, at which the maximum potential was obtained. The glow of the lamps gradually increased in the same manner, and maintained their intensity as long as the coil was allowed to remain at the point of resonance. During all the variations of potential on the lamp circuit while the tuning was in progress and after resonance had been obtained the voltmeter V connected to the secondary terminals showed invariably 150 volts, indicating that the rise in potential at the lamp terminals was due entirely to resonance effects.



DR. PUPIN'S RESONANCE CIRCUIT FOR LIGHTING.

As it was Dr. Pupin's sole object to show that glow effects could be obtained from circuits at ordinary commercial frequencies no attempt was made to bring the lamps up to a high degree of luminosity, but, as Dr. Pupin stated, the raising of the frequency to only 1,000 periods per second, which is well within commercial limits, would have brought out a greatly increased luminosity, while at the same time cutting down the capacity of the condensers required to nearly 1-64 of that employed by him in the experiment.

DEPTH OF THE LONDON SUBWAYS.

The new city and Waterloo subterranean railway line in London will, in its passage up Queen Victoria street from the Thames, run for a part of the way underneath the low level main sewer, which in its turn runs along beneath the District Underground Railway. At this point in the city, therefore, there will be first a busy main thoroughfare, below that a steam railway, then a huge metropolitan sewer, then an electric railway, reaching its terminus at a depth of about sixty-three feet below the streets, and here it will communicate with another line—the Central London—which will lie at a depth of eighty feet.

SHEFFIELD LABORATORY.

The new Sheffield Laboratory for the Scientific Department of Yale will be four stories high and seventy-two feet front by 180 feet deep. This will be, it is said, the largest and best college laboratory in the country, and will cost $180,000.

THE EXCELSIOR ELECTRIC CO.'S SELF-STARTING SYNCHRONOUS ALTERNATING MOTOR.

Two-phase and three-phase transmission has of late so absorbed the attention of electrical engineers that the opportunities for single phase motors, to be coupled direct to alternating circuits as now generally installed, seem to have been apparently lost sight of. That a demand for such motors exists is but too well known and though attempts have been made to supply it in the past there is still a wide field open to machines of this type.

Recognizing this fact the Excelsior Electric Co. have just brought out the alternating motor illustrated in the accompanying engraving, Fig. 1. This is a synchronous machine, designed to be self starting, which is accomplished by means of a small auxiliary continuous current motor mounted on a bracket and coupled directly to the alternating armature shaft. This auxiliary motor is employed merely to bring the alternator up to synchronism, after which it is switched out and plays no further part in the working of the machine.

The diagram, Fig. 3, shows the windings and connections, from which the operation of the machine will be readily understood. The current from the alternating source controlled by a starting switch A, goes to the binding post P, from whence it is led through an auxiliary winding on every other pole of the field. From the field it goes through the armature by way of the brushes G, G′ back to the binding post P′ and thence out to the return circuit. This winding is simply used to get up the required speed. When this speed has been attained, the exciter is in condition to produce just the amount of current that is wanted and rings the bell B. This gives the operator warning, and he immediately presses down the lever L which forms the connections at points 1, 2 and 3. At the same time by means of the peculiar brush rocker, the brushes G, G′, are automatically lifted from the commutator. The pins C, C′ force the lower arms of the rocker nearer together which action pulls the upper arms further apart and so lifts the brushes off the commutator.

This sets up an entirely new action. The alternating current of the circuit no longer goes from the binding posts P, P′ through the field and armature, but, instead, is led to the point 2 where the connection has been formed which sends it to the collecting ring R through the armature back to ring R′ to the point 3 and to post P′ and thence out to the return circuit. The fields are now excited by the current from the exciter E. This current goes to point 1 where the connections just formed allow it to go through the main windings of the field, which is wound in alternating series. From the field it goes back to the exciter. This magnetizes the field with a direct current while the armature is excited by the alternating current from the circuit.

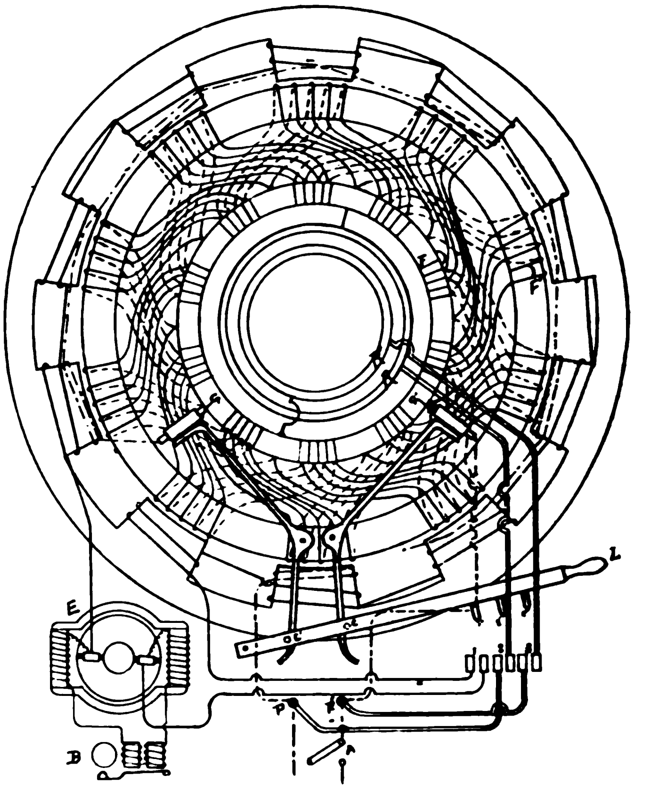


FIG. 3.—DIAGRAM OF EXCELSIOR SINGLE-PHASE ALTERNATING MOTOR.

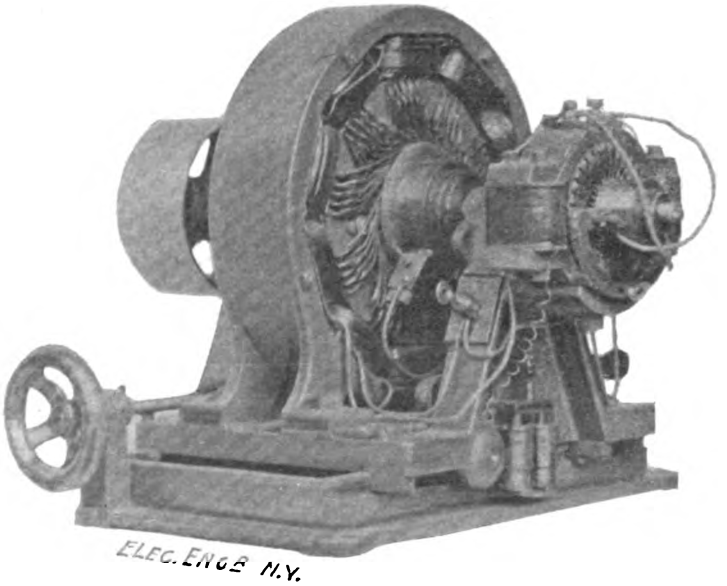


FIG. 1.—EXCELSIOR SINGLE-PHASE ALTERNATING MOTOR.

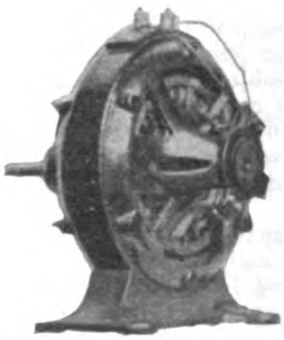


FIG. 2.—EXCELSIOR ¼ H. P. SINGLE PHASE ALTERNATING MOTOR.

At the first glance, one would naturally wonder how the armature windings are brought to the commutator in unending series when there are the same number of coils in the armature as there are segments to the commutator. This is readily understood by a closer inspection, when it will be observed, that two commutator segments are short circuited at F and two armature coils at F′ are practically made into one coil of twice the number of turns, which arrangement readily allows of the unending series, as can be seen by tracing the winding and connections of a single coil.

The engraving, Fig. 2, shows a ¼-H. P. motor adapted for single-phase alternating currents. This machine has a ring armature with 24 polar projections, revolves in a six-pole field, both parts being well laminated.

Twenty-four coils are wound on the armature and connected to a twenty-four segment commutator, the segments of which are cross-connected, each section to every other one hundred and twenty degrees removed. By this method of joining the coils, the current is distributed through six of them in multiple arc and four in series by means of but one pair of brushes. The field coils are all in series with each other and with the armature.

These motors are intended for driving small machinery such as lathes or drills, etc. When mounted on a high pedestal driving a 16 inch or 18 inch fan they act as powerful ventilators. With the base detached and hung from the ceiling by means of a tube, they will drive a pair of blades with four feet spread at two hundred revolutions per minute. When the motor is utilized to drive machinery which needs to revolve at uniform speed under changing load it is supplied with a centrifugal governor which maintains the speed by shifting the brushes.

COST OF TRANSMITTING NIAGARA WATER POWER.

BY H. WARD LEONARD.

CONCERNING the results obtained by Messrs. Houston and Kennelly as to the Niagara transmission, I differ radically from them as to the commercial results possible. I have not had time to go into the matter carefully, but I assume that the results obtained by them are correct deductions from the assumptions made. It is in their assumptions that I cannot agree with them.

I cannot conceive that capitalists would be satisfied with a return of 5 per cent. per annum on a venture so full of doubt as this, and with such enormous losses in case of failure. My experience leads me to the belief that nothing less than a return of about 15 per cent. per annum in case of success will induce capitalists to take the chances of a nearly complete loss of capital in case of failure, which certainly must be considered in a transmission such as that from Niagara. A return of 5 per cent. which Messrs. Houston and Kennelly allow can be secured from first-class bonds in which the chances of loss of the capital is practically eliminated.

Messrs. Houston & Kennelly assume an average load for 24 hours of 60 per cent. of the maximum load. This seems to me extraordinarily high, based on the statistics of the most favorable practice up to date, and I believe 40 per cent. of the maximum load will not be exceeded as the average load in such a transmission.

Messrs. Houston & Kennelly have assumed a cost of $14.95 per K. W. as the purchasing cost of motors and step down transformers combined. In arriving at this figure they have assumed 1,000 K. W. as the smallest motor unit. When we consider that such a motor would supply a factory using steam engines of 1,500 indicated H. P. we must wonder where opportunities will be found to sell the enormous power to be disposed of. If motors of 25, 50 and 100 KW. be considered which are much more likely to be the sizes used, even in large factories, the cost per KW. for step-down transformers and motors will be about $25 per KW. instead of $14.95.

Messrs. Houston & Kennelly assume an efficiency of 98 per cent. for step-down transformers, and 96 per cent. for motors, which seems extremely high. This makes a combined efficiency of 94 per cent. which seems more likely to be 85 per cent. in practice, as such an efficiency as they assume is only possible for very large motors at full load, if even then.

It does not seem reasonable to me that a manufacturer having a steam plant already in operation will consider taking electric power unless there is a saving of nearly 50 per cent. in the cost of power, for he must still retain his boilers for heating, and, as his engineer acts usually as machinist for all his machinery, he cannot save his salary by using electric power. In most industries the cost of power is not more than 10 per cent. of the cost of manufacture, and if there be any considerable increase in the liability of failure of power it will require a very great inducement in order to make the change to electric motors attractive. Furthermore, most manufacturers believe that they are producing power at about ½ to ⅔ of the figures given by Emery's tables, and although they are probably in error it is their low estimate of their cost of production of power which must be materially reduced before the proposition to use electric power becomes attractive to them.

All of Messrs. Houston & Kennelly's figures are based upon a sale of 119,000 H. P. In order to produce this maximum load probably 300,000 H. P. must be sold, as represented by the aggregate rating of the motor capacity. This is an enormous amount of power, and is not likely to be sold this year nor next. If we consider the cost of plant per KW., and the cost of operation per KW. under conditions of only one-quarter of this amount of power sold, which is likely to be the situation for some years, and consider any reasonable return for capital invested in such a speculative business, the losses are appalling and only a tremendous counter-balance in the shape of a real estate "boom" seems likely to make the capital invested productive.

I am of the opinion that a power plant using triple expansion engines, and continuous current apparatus, located on the water front in Buffalo will be able to compete with power transmitted from Niagara successfully. There are scores of places in the United States where power is almost, if not just, as cheap as at Niagara, and where within short distances large amounts of power are used with very high cost for fuel, and where the chances of commercial success in the electrical transmission of power seem to be much greater than at Niagara.

For the sake of electrical development it is to be hoped that the Niagara transmission will prove a great success commercially, but in case power from Niagara cannot compete with steam power at Albany it should be remembered that this will be due not to the high price of the transmitted power, but to the cheapness of the local steam power.

THE COST OF TRANSMITTING NIAGARA WATER POWER.

BY J. B. CAHOON.

The prices which Messrs. Houston and Kennelly quote for generators, motors and transformers might possibly be obtained were the total of all the plants to be contracted for purchased on a single order, but I very seriously doubt whether they could get them as cheap as quoted even then. Again, they figure on a cost of $3 per ton for coal where used to produce steam power; this, as we all know is about double what would be paid for the kind of coal used in large plants for the production of steam and I notice that they also base their cost on the average load being 60 per cent. of the maximum; this I believe will not hold true in actual practice.

In fact, a general criticism can be made which will cover the whole article and that is, a factor of safety of *two* should be introduced. Making the changes involved by the introduction of this factor would, I believe, place the cost of producing electricity at the different points about where it belongs and would evidently make a very material change in the conclusions arrived at.

AN ESTIMATE OF THE DISTANCE TO WHICH NIAGARA WATER POWER CAN BE ECONOMICALLY TRANSMITTED BY ELECTRICITY.

BY EDWIN J. HOUSTON, PH. D. AND A. E. KENNELLY, F.R.A.S.

WE note with interest the communication in the issue of THE ELECTRICAL ENGINEER for May 30, p. 468, by Professor F. B. Crocker and Mr. C. F. Rittenhouse, upon a recent article written by us on Niagara power transmission.

Messrs. Crocker and Rittenhouse state that in their judgment, "It would have been more appropriate to have considered the problem on the two-phase basis, since this is the system adopted by the Niagara Company." We submit that this is really an irrelevant matter, since we did not attempt in our paper to discuss the particular system adopted by the Cataract Construction Company, but rather a general electrical engineering problem connected with Niagara power.

It is also stated that, "We think 10 per cent. too small for the annual interest, depreciation and repairs. At least 5 per cent. should be added for litigation, accidents, interest on unproductive capital and general contingent expenses." To this we would answer that we did not intend our estimates to cover the hypothetical costs that might exist due to accidents or unforeseen causes, but based our figures on what could be considered fair charges on capital. Considering the high character of the engineering skill engaged on this project, we believe that our estimate of 5 per cent. for depreciation and repair is fair, and we have yet to learn that 5 per cent. is not a fair return on capital at the present time.

The article proceeds to state: "The efficiencies assumed seem too high. Thus their figure of 0.96 efficiency for the generators or motors, and 0.98 for the transformers might be realized on a test under the best circumstances, but are very high for ordinary commercial conditions, and they are certainly not 'conservative' as their authors claim." * * * "An efficiency in the line of 55 per cent. in the transmission to Albany, which would obtain, according to their figures, appears low, but may be warranted on the basis of their assumptions."

We are no little perplexed as to which of these conflicting views we should regard as the real criticism of the article; viz., whether our efficiencies are estimated too high or too low. We would suggest, however, that our estimates were not for ordinary sizes of machines which might be, say, from 1 to 100 H. P., but for the extraordinary size of 5,000 H. P., and since the efficiency is known to increase continuously with the size, and the efficiency of dynamos and transformers exceeded 95 per cent. in the published Lauffen-Frankfort transmission, when their capacity did not exceed 300 H. P., it is reasonable to expect that the figures we have assumed will be amply justified.

The article goes on to state that Dr. Emery in his paper on the cost of steam power has based his estimates on a 500 H. P. steam engine unit, and at $68 per H. P., whereas our figures showed $6.352 per H. P. for dynamos and accessories. To this we would reply that Dr. Emery is on record in the Transactions of the American Institute of Electrical Engineers, Vol. X, p. 159, as having stated that he would be unable to predict whether the operating expenses of a steam plant made up of units of 2,500 H. P., would be more or less than one of equal total capacity in units of 500 H. P., and that the principal saving in the adoption of 2,500 H. P. units as against 500 H. P. units, would be in connection with real estate.

If the estimates for cost of steam power, made by Dr. Emery in his able paper read before the American Institute of Electrical Engineers, require any amendment in order to fairly meet the facts of the Niagara power transmission, that is a matter which cannot fairly be said to affect our estimates.

THROUGH the courtesy of the Editor of THE ELECTRICAL ENGINEER, we have received an advance copy of an article by Mr. H. Ward Leonard entitled "Cost of Transmitting Niagara Water Power." We regret that Mr. Leonard has "not had time to go into the matter carefully," since otherwise some of the statements made in his article might possibly have been omitted. We think that Mr. Leonard's criticisms are open to two broad objections, namely:

(1). That we cannot be fairly regarded in any respect as assuming the position of promotors. Our sole object, as we believe is indicated by the title of our article, was to form a fair estimate of the distance to which Niagara water power might be carried.

(2). That Mr. Leonard has apparently failed to grasp the great difference between the character and conditions of a problem on such a scale as that of Niagara power distribution, and ordinary commercial problems as they have usually hitherto presented themselves, in which only a comparatively small horse-power has been involved.

To the statement, "I cannot conceive that capitalists will be satisfied with a return of 5 per cent. per annum, on a venture so full of doubt as this," we would reply that this has nothing to do with the problem we considered, which was the cost of transmitting power, and the yearly value of money expended on plant.

Mr. Leonard says that we "assume an average load for 24 hours as 60 per cent. of the maximum load. This seems to me extraordinarily high, based on the statistics of the most favorable practise up to date, and I believe 40 per cent. of the maximum load will not be exceeded as the average load in such a transmission."

While such an objection would be quite fair for central station transmission as dealt with in ordinary practise, it would certainly not hold for such conditions as would in all probability exist in the transmission of power from Niagara; for, in central station loads the electric lights and motor power, which are very generally distributed, have an irregular rate of supply, whereas, the greater part of the power transmitted from Niagara must necessarily be to large consumers in block, and such consumers in their own interests would maintain as nearly uniform a load as possible.

As regards the query, "where users will be found for such large motor, units as 1,000 kilowatts," we can only say that the very facilities offered for the delivery of cheap power in large units will create the demand, as indeed, if the newspapers are to be believed, it has already done in the case of Buffalo city.

As regards the efficiency of a step-down transformer and motor which Mr. Leonard regards as probably 85 per cent., we desire to point out that only in one case have all the facts concerning a long-distance transmission plant and its efficiency been carefully examined and fully published. This was in the Lauffen-Frankfort transmission of 1891. Here the average efficiency under all loads is recorded as 72.5 per cent. including the loss in line conductors, 109 miles in length, and this on a plant far smaller, and consequently, it is only reasonable to suppose, decidedly less efficient than that we have considered. If, however, Mr. Leonard's estimate of 85 per cent. efficiency were correct, such a net efficiency could not have been obtained.

If the following remarkable statement of Mr. Leonard, "I am of the opinion that a power plant using triple expansion engines and continuous current apparatus, located on the water front in Buffalo, will be able to compete with power transmitted from Niagara successfully," be justified, then it might be desirable for the Cataract Construction Company to cancel the contracts it is said to have entered into, and to retire from business.

The concluding paragraph leaves us in doubt as to the position Mr. Leonard actually takes concerning this problem, but we quite agree with him that, "In case power from Niagara cannot compete with steam power at Albany, it should be remembered that this will be due, not to the high price of the transmitted power, but to the cheapness of the local steam power."

LABORATORY OF HOUSTON & KENNELLY,
PHILADELPHIA, May 30, 1894.

ALTERNATING CURRENTS AND FUSES.[1]

BY PROF. DUGALD C. JACKSON AND R. J. OCHSNER.

THE following work was undertaken with a view to studying the disintegrating effect of alternating currents on fuse metals which has been reported, and, if possible, ascertaining the cause. As the work done at Cornell University[2] last year showed such a remarkable rise of resistance, and a lowering of the fusing points of the fuses placed on the alternating circuits, the authors decided to repeat the experiments, and if any change in the resistances should take place to prolong them.

1. *The Effect of Alternating Currents on the Resistance of Fuses.*—Samples of fuse wire of five amperes rated capacity were obtained from five different manufacturers, and to these were added a 30 ampere fuse wire which we happened to have, and a copper, a german silver, and an iron wire. Pieces of wire from each sample, each of them varying from nine to ten feet in length, were wound upon cylindrical pieces of pine wood about a foot long and one and one-half inches in diameter. The table below gives the names of the firms from which the samples were obtained and their rated capacities:

	Rated Capacity.
Ansonia Electric Co. (Wirt fuse wires)................	30
Shawmut Fuse Wire Co. (two samples)...............	5
The Independent Electric Co.........................	5
Peru Electric Manufacturing Co..................	5
The E. S. Greeley & Co..............................	5
Taylor, Dee & Mack..................................	5
Iron wire..	
German silver wire..................................	
Copper wire...	

The resistances were determined by means of the Anthony bridge in the laboratory of the University of Wisconsin, the readings being taken to the fourth decimal place.

The fuses were put on the alternating lighting circuit which furnishes the light for the laboratory. Enough resistance was put in series to give a current of about three amperes. The pressure is 110 volts, and the frequency, approximately, 125. The resistance of the fuses was measured at fairly regular intervals, and the corrected results were plotted, Fig. 1.

It was also decided not to pass any current through the fuse for some time, but to measure the resistance, as before, from day to day, being very careful in getting the temperatures accurately. It was found practically impossible to get the temperature of the fuses correct within a few tenths of a degree because the temperature of the room would vary in spite of all care, and the fuses would not follow this variation so rapidly as the thermometer indicated it. Nevertheless, far better results were obtained than before. The result of this part of the work is shown by the curves between the two heavy vertical lines.

After this the fuses were again subjected to the alternating current for about 100 hours, measurements of resistance being made daily. Each day, as the current was turned off, they were cooled down rapidly by taking them into a cold room and leaving them for some time, after which they were brought back to the working room and allowed to stand for about five or six hours before measuring the resistances. The results are shown by the last part of the curves. As fuse No. 3 seemed to show greater irregularity than the others, another piece of the same sample was added. It is the one numbered 10, and the curve is plotted directly under No. 8 for comparison.

From the fourteenth point on, the curves are all practically straight horizontal lines, the irregularities being about the same when no current passed as when it did. Nearly all the points on the curves before the fourteenth were considerably higher. This shows plainly that the fuses had not cooled down to the temperature of the room when the resistance measurements were made, the variations depending on the length of time they were allowed to stand. Considering the average values of the last parts of the curves to represent the true resistances, the greatest variation was 1.8 per cent. in the case of No. 3, and even this is not too large to be explained by the above errors. In proof of this the resistance of one fuse was measured immediately after turning off the current, and also 15, 20, 35 and 50 minutes later, and the errors found to be respectively 8 per cent., 6.2 per cent., 3 per cent., 2.8 per cent. and 1 per cent.

---

[1] Abstract of a paper read at the Meeting of the American Institute of Electrical Engineers, Philadelphia, May 16, 1894.

[2] "The Action of Continuous and Alternating Currents on Fuse Metals," by C. P. Matthews; *Transactions* A. I. E. E., vol. x, p. 251.

That the first point on each curve is nearly as low as the final values is due to the fact that current had not been passing through the fuses before that measurement was made, and the fuses were, therefore, at the temperature of the surrounding air which was recovered by the thermometer. Another proof that the variations are due to temperature is shown by curve No. 9. This represents a wire which has a very small temperature co-efficient, and accordingly it varies the least of any. While the actual rise in curve No. 3 is much greater than in any of the others the percentage rise is only slightly greater, the resistance of the fuse being the largest of all.

These experiments prove that there is no appreciable rise of resistance in fuses subjected to alternating currents, at least not within a period of 550 hours. More accurate results might undoubtedly have been obtained had the fuses been mounted in such a manner as to avoid contact with any large masses of solid material, but the accuracy is amply sufficient to prove the case.

These results are diametrically opposed to those given in the report of similar work, published in the A. I. E. E. *Transactions*, vol. x, p. 262, already referred to. While, in the latter investigations, corrections were made for the standard resistance with which the fuses were compared, no such corrections were made for the fuse wires. The fuses were subjected to larger currents than in my tests, with consequent greater heating. The resistances were apparently measured without allowing sufficient time for the fuses to acquire the temperature of the room, and even if this was done the variation in temperature of the room as given in the original report of the investigation (which Mr. C. P. Matthews, Instructor at Cornell University, kindly sent me) was sufficient to introduce serious errors. The resistances were measured by the fall of potential method. According to the drawing, showing the arrangement of the apparatus, no extra resistance is put in series with the battery to reduce the current strength. This current may have been sufficiently great, in the smaller sized fuses at least, to cause considerable heating. For these and other reasons relating to the accuracy of the tables, I think that this part of the work reported by Mr. Matthews is not to be relied upon, and, therefore, the conclusions based upon it are of no value.

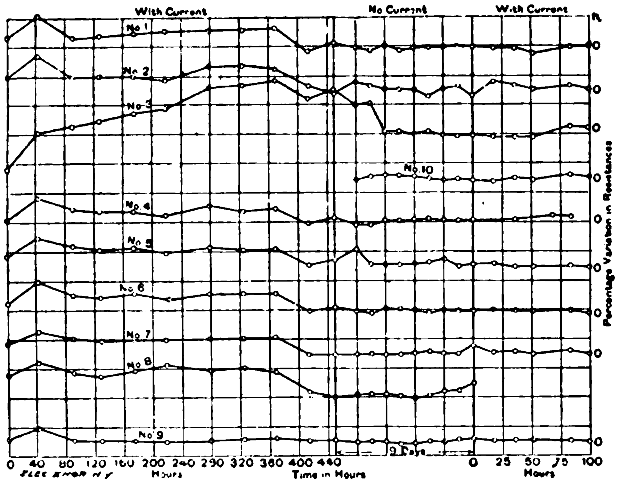


FIG. 1.—PERCENTAGE VARIATIONS IN THE RESISTANCE OF FUSE WIRES.—VERTICAL SCALE, 1 DIVISION = 1 PER CENT.

2. *The Effect of Alternating Currents on the Fusing Points.*—Next the fusing points before and after passage of current were determined. As the continuous current from the dynamo which was available was too variable, a few storage cells for fusing the wires were used. Only the five ampere wires were tested. A number of pieces of each of these were tested; half of these had been subjected to the alternating current and half had not.

Four of these samples showed a slight lowering while two show a slight rise in the fusing point, but the differences were of the same order as the differences between individual test pieces. While a test of only a comparatively small number of fuses in this way hardly establishes the correctness of the results, a slight change in the fusing points probably did take place, as was shown by the fair uniformity of the figures in each sample. That such slight change as did occur was due to oxidation there is also little doubt, for all of the old fuses showed slight oxidation, and the effect was too small to be of practical moment. As to the results in the earlier investigation already referred [*Trans.*, Vol. x, p. 65], on the fusing points, only the averages are given, and no mention is made of temperature; therefore it is impossible to properly judge of their accuracy. As far as can be determined from the original report, however, the tests do not seem to be any more reliable than the resistance tests.

3. *Conclusions.*—In the light of the experiments herein described, and the statements made by Cockburn, Salomons, and Matthews, is it necessary to ascribe a slight change in the properties of the fuse to the disintegrating effect of the alternating current? It is thought not. The experiments recorded represent the conditions of ordinary practice and prove that a fuse as used in practice is not directly affected by the alternating currents. Fuses on alternating current circuits are sometimes found to blow without apparent reason, but something outside of the disintegrating effect of the current is the cause. Under some conditions the result has come about through the mechanical shaking to which an alternating current fuse is sometimes subjected when not tightly clamped by the terminal screws.

ELECTRICITY AND PHOTOGRAPHY.

IN the May number of the *Cosmopolitan Magazine*, Prof. A. E. Dolbear makes the following suggestive remarks on the above subject:

For a long time it was believed there were three different kinds of ether waves, known as heat, light and actinic rays. The latter were supposed to be the ones that produced the chemical action on photographic plates, while light consisted of rays of a different kind, capable of affecting the eye. It was discovered, however, that the same rays that can produce vision can also heat a body, and also do photographic work, and what any ray can do depends upon the kind of matter it falls upon, so that all rays have similar characteristic properties. This discovery makes it plain that there is no peculiar kind of ether waves which can be called light, as distinguished from other kinds of ether waves. What is called light is a physiological phenomenon, and has no existence apart from eyes. So well assured is this, that the serious proposal is made to banish the word "light" from physics.

The sensitive coating upon a photographic plate is an unstable chemical compound, which may be broken up by mechanical pressure, by heat, or by ether waves. The proper wave length for a given plate depends upon the nature of its surface. The tanning of the skin, the darkening of newly-laid shingles, the coloring upon apples and other fruits, is a photographic process, as can be shown by shielding them from the sun's rays. It has long been known by photographers that pictures may be taken with ether waves much too long to be seen by the eye, if some other substances are used in place of the simple silver salts in common use.

Since it has been shown that ether waves of all lengths have an electromagnetic origin, it has been apparent that all the effects of light can be duplicated with suitable electric apparatus. Lay a coin, like a half dollar, on a plate of glass and let a few sparks from an electric machine fall on it. Remove the coin, and the glass surface will not appear to have been affected; but if it be breathed on, the image of the coin will at once be seen, and that it is really engraved on the glass surface is evident, for it will not easily rub off. If a piece of photographic paper takes the place of the glass, it must have the imprint of the coin made upon it. It is not needful to have the sparks fall upon the coin, for, if it be enclosed in a dark box, brought near to an electric machine having short sparks passing between its knobs, the ether waves set up by the latter will be sufficiently short to affect the photographic surface, which may be developed afterwards in the ordinary way. So it is actually possible to take a photograph of an object in absolute darkness, with the ether waves set up by working an electric machine. Not much has yet been done in this direction, but it is a new clew to chemical possibilities, and one may confidently look forward to the time when the qualities and colors of surfaces of many things will be changed to suit the taste by an application of electric waves of suitable length to bring about the proper chemical reactions, and an electric machine may become a necessary adjunct to the apparatus of the photographer.

THE JUSTIFICATION OF MISS MEANS.

MISS SADIE M. MEANS, an employee of the Telephone Exchange in Columbia, S. C., was dismissed by the session of the Second Presbyterian Church of that city for violation of the Sabbath, in that she performed her duties at the exchange on Sunday from 9 o'clock A. M. to 1 o'clock P. M. The case was appealed to Charleston Presbytery, which endorsed the action of the session. The appeal was then carried to the Synod of South Carolina, and this body reversed the action of the Presbytery and of the session, and ordered Miss Means restored to the church. This the session failed to do, and the Charleston Presbytery appealed to the General Assembly. After a long argument the vote to sustain was 48; to partially sustain, 8; not to sustain, 77. The effect of this action of the Assembly will be that Miss Means will be restored to communion in the Second Presbyterian Church.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

Edited by
T. Commerford Martin and Joseph Wetzler.
Associate Editor: George B. Muldaur.

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Western Editor and Manager C. Kammeyer, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. Hanks.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies, - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

Vol. XVII. NEW YORK, JUNE 6, 1894. No. 318.

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TROLLEY OVERHEAD CIRCUITS.

IT is not so long since that the electric light companies in some of our largest cities, having often shown an utter disregard of the rules governing decent and safe line construction found themselves in the dilemma of either putting their wires underground or going out of business. They chose the former, but at a cost which has probably made what was formerly a good paying business an unprofitable one. It may be somewhat late in the day to say so, but we believe, nevertheless, that if such electric light companies had exhibited any real desire to make their circuits as safe and unobtrusive as every electrical engineer knows they can be made, the large majority of the wires now buried would still be overhead. With this experience of the electric light fraternity before them, it is scarcely to be believed that electric railway interests would follow a practice which must inevitably lead to like results in the end in their case. We need go no further than the city of Brooklyn, N. Y., to find a model example for the moralist. The very latest of our large cities to adopt electric railways, it presents probably as good an instance as could be found of short-sighted policy and, what is more, of almost criminal negligence in view of the state of the art.

To say that the railway current is being tapped all over the city for lighting, operating motors, telegraph circuits, etc., is to give some indication of the wretched conditions existing. To the unquestioned danger from fire due to leaks, there is added the equally important destructive effect of electrolytic action, not only on water and gas pipes but on the elevated railway structure itself, which shows a difference of potential to ground, exceeding 100 volts in spots. Attempts are being made to remedy these evil effects by putting up heavy overhead return conductors, but these cables, with the feeders as thick as one's wrist, simply cast into the shade the old familiar sky-obscuring electric light lines. We are not among those who stickle for the æsthetic in engineering, but we submit that good engineering of itself would have precluded the putting up of such conductors on poles in city streets. There can be only one outcome of this outrage upon public decency and insult to the profession of electrical engineering; and it is to be hoped that, for the sake of both, these monstrosities may soon be wiped from the face of the earth. It is not without reason that the Fire Underwriters have raised their rates beyond the Harlem River in New York and a similar action which may be expected to involve Brooklyn will raise such a storm of public condemnation that further delay in placing all feeders and returns underground will be impossible. Even the acknowledged popularity of the electric cars in Brooklyn will not be able to avert the storm which is gradually but surely gathering.

ALTERNATING CURRENTS AND FUSES.

The peculiarities, not to say vagaries, of the alternating current have given rise to more than one superstition in electrical working, but one by one these fallacious ideas are being rooted out by the investigations of competent experimenters. One of the notions of this kind which has gained wide acceptance as the result of the frequency with which converter fuses blow is, that the alternating current in some way causes a change in the molecular constitution of the fuse metal, in virtue of which its resistance is increased. To the testimony of those who handle converter fuses in their daily work there was even added the confirmation of tests made in the laboratory which seemed to show the truth of the generally accepted reason for the phenomenon. It would seem, however, that our preconceived notions must be modified to some extent at least in the light of more recent investigations, as embodied in the Institute paper of Messrs. Jackson and Ochsner, printed elsewhere in this issue. The result of their tests of fuse wires show that the change in resistance extending over a current period of 550 hours is practically negligible and hence that we must look in other directions for the cause of the frequent blowing of converter fuses. The authors briefly hint at the mechanical shaking to which converter fuses are sometimes subjected when not tightly clamped by the terminal screws. We are left in doubt whether the authors intend to imply that this vibration of itself, caused by the molecular magnetic changes, is sufficient to change the physical character of the fuse metal and to give rise to the supposed increased resistance. It seems to us, however, that a more plausible explanation would be based on the assumption that the vibration under a loose contact screw starts a small arc which finally leads to the destruction of the fuse. This view also seems justified by the fact that it has become the practice in not a few central stations to send men around at regular intervals to tighten up the fuse clamp nuts. While the conclusions reached by Messrs. Jackson and Ochsner are probably correct within the limit of time to which the fuses were subjected to the passage of the current, it would be well to continue the experiments in order to determine whether the time effect is practically negligible. The unstable resistance of alloys is well known, its magnitude varying of course with the nature of the alloy; if to this be added the effect due to the current it is not beyond the bounds of possibility that fuse wires may change appreciably after a lapse of time exceeding that indicated in the tests cited above. As a matter of fact alloys have been to some extent abandoned as fuse material, and as we cannot assume that all past experience is at fault in this matter, it seems to us that the subject is of sufficient importance to warrant further investigation.

NOT CHRIST, BUT A CANDLE.

When the Brooklyn Tabernacle was destroyed recently by fire, for the third time, and the occurrence was once again attributed to electricity, we ventured to express our grave doubts whether electricity had had anything more to do with it now than before. The investigation that followed soon showed that whatever else might be the cause, it was not electrical. Thus arose the need of a new theory for what still remains a very suspicious fire, and, nothing loth, the officers of the church had a new theory to air. We give it in the exact words of Mr. Leonard Moody, chairman of the Tabernacle board of trustees :—

> "That fire," said Mr. Moody, earnestly, "was a providential dispensation. *I think it was Christ's way of helping us.* He certainly did help us, I think. After I got in the board we paid all our current obligations. We got the Sage mortgage extended. We raised money by popular appeal. We did all we could and then Dr. Talmage preached his farewell sermon.".
>
> "And then," he continued, in a slow and solemn voice, "Christ said to us: '*Boys, you've done well.* I'll relieve you of your troubles.' And then *He burned the church.*"
>
> As Mr. Moody uttered these last words his voice sank almost to a whisper and his manner was intensely earnest.
>
> After a pause of a minute, Mr. Moody became more cheerful.
>
> "I don't believe," he said, "that Christ believes in running a church under a big debt. He called us to a halt for that reason. I don't believe Christ believes in running a church with any debt. *If He does, I don't.*"

That explains everything, of course. Most men would hesitate, nowadays, to represent our Saviour in the light of an incendiary ; but no such misplaced reverence checks a Talmage trustee. The only wonder is that when the timely fire had been so "providentially" started, Mr. Moody and his colleagues did not help it along.

The investigation into the origin of the fire has resulted in a verdict that it was due to a candle carried by a man inside the organ that Sunday morning. This explanation certainly seems more natural, though less cheerfully blasphemous than Mr. Moody's. At any rate, as we said while the ashes were still red hot, electricity had nothing whatever to do with it.

LETTERS TO THE EDITOR.

BABCOCK & WILCOX BOILER TESTS.

I HAVE not yet seen the full account of the test of the Babcock & Wilcox boilers at East Cambridge referred to in your issue of May 23, but I can bear witness that on occasion a Babcock & Wilcox boiler will prime ten to twenty per cent. for a quarter of an hour or more at a time, as determined by a separating calorimeter, a throttling calorimeter reading 212° during all the time. On several occasions I have taken three or more successive readings at half hour intervals, showing from ten to twenty per cent., and I have taken single readings showing forty per cent. The same boiler will, however, give less than three per cent., during four-fifths of the time, and on one test twenty-one readings at half hour intervals gave as maximum priming two per cent. and an average of one and one-tenth per cent.

R. S. HALE.

BOSTON, MASS.

BUS OR SELF-EXCITED FIELDS.

THAT self-excited dynamos are better adapted for central station practice than purely bus-excited fields, is a statement in which I fully concur with Mr. Herrick, as stated in his letter in your issue of May 23; but it is equally true that either system possesses advantages over the other, under different conditions, as enumerated in the same gentleman's paper read before the National Electric Light Association meeting at Washington. In view of the above statement, it is evident that a station embodying the advantages of both systems will display a greater degree of flexibility than if operated with either alone, and this is made possible by the diagram of connections shown in your issue of May 2, page 392.

In his criticism of my method of field excitation, page 460, May 23, Mr. Herrick assumes a very unusual routine for starting a dynamo, which might render the dynamo liable to damage from its own field discharge; but I can see no more reason for throwing the shunt field switch on its bus-exciting terminal before the dynamo is up to speed,—and consequently not ready to be shut down quickly in the normal way if occasion demanded it,—than to take the unusual course of shutting down one of a group of dynamos by raising the brushes from the commutator. A man who would operate a plant in this way should not be entrusted with the care of dynamos in multiple.

My criticism of Prof. Anthony's rheostat was merely a plea for single-pole apparatus throughout the switchboard of a railway plant, and it will be noticed that only such is included in my diagram, thus eliminating the possibility of a short circuit within the bounds of the switchboard.

C. S. VAN NUIS.

NEW YORK CITY, May 25, 1894.

TORONTO ELECTRIC LIGHTING.

The report of the city engineer, Mr. Keating, has been made public on the estimated cost of an electric light plant and the operation of the same by the city. The total cost of the plant is placed at $310,200, and the estimated cost for operating $106,324. On this basis the cost per lamp would be $81.78 and $75 each, instead of $108.58 each all round, as at present. Mr. Keating recommends the city council to undertake the work at once, while prices are low and labor is overabundant.

ELECTRIC TRANSPORTATION DEPARTMENT.

THE CARD ELECTRIC COMPANY'S SINGLE MOTOR EQUIPMENT FOR STREET RAILWAYS.

THE question of single *vs.* double motor equipment for street cars running upon tracks with ordinary grades is one that is of special interest to railway companies as well as to manufacturers of electric railway apparatus, and the Card Electric Company, of Mansfield, Ohio, has treated the subject in a most practical manner by placing single equipments upon cars in regular service and observing their action as compared with the double motor equipment in ordinary use. As a result of its experiments the company has become convinced that a single motor equipment can be built of sufficient power and traction to move a loaded car over ordinary grades at a satisfactory speed, and, at the same time, be just as reliable, convenient and practical as a double equipment; that the first cost and the expense for repairs will be less, and that, therefore, one motor on a street car is better than two.

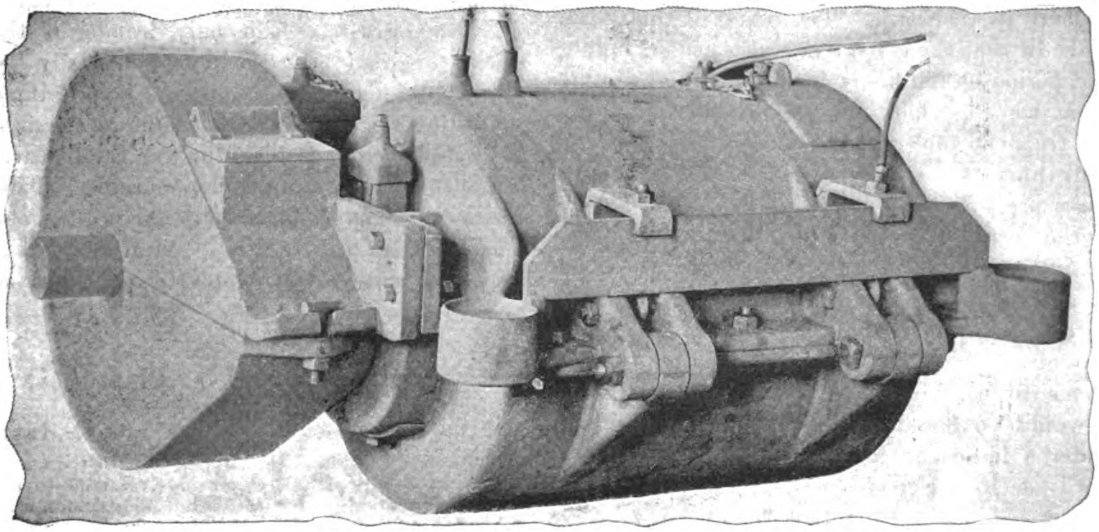


FIG. 1.—CARD ELECTRIC RAILWAY MOTOR FOR SINGLE EQUIPMENTS.—REAR VIEW.

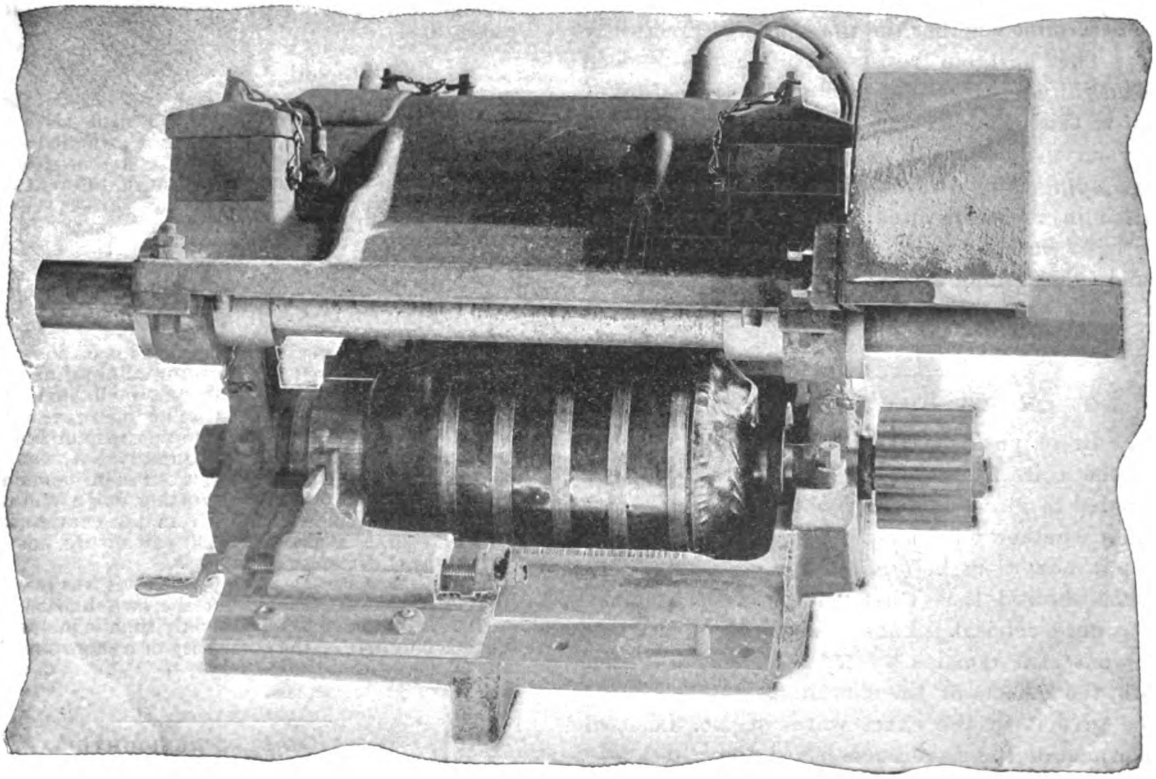


FIG. 2.—CARD ELECTRIC RAILWAY MOTOR FOR SINGLE EQUIPMENTS.—FRONT VIEW.

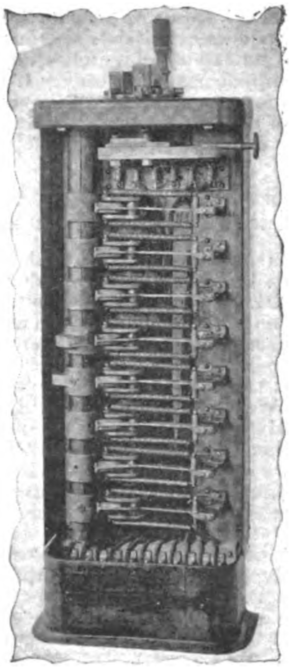
The company, carrying out its ideas in this direction, has designed for the service specified the motor shown in the accompanying illustrations. In large cities where trailers are used the single equipment is not advocated and the company is now preparing a double equipment possessing the same features of simplicity and completeness of detail as that described. This has not yet, however, been placed upon the market.

In the illustrations, Fig. 1, shows a rear view of the single motor equipment, a novel feature of which is the steel bar for strengthening the cast extensions that form the spring supports. The bar rests in grooves, cast for the purpose, and is clamped down by two eye-bolts fastened by pins between the hinge ribs at the bottom, and clips over the top, dividing the strain equally between four points, overcoming the danger of breaking after long service, through a gradual crystalization of the cast metal.

A view of the motor case open is shown in Fig. 2, with the lower half of the case lowered, exposing the armature and field coils, for inspection or removal. The modus operandi of this is quite simple and it requires but little time. A small chain block, fastened to a beam of the car body by means of an eye-bolt, and to the lower half of the motor case at the extension shown in the centre, enables one man to raise or lower it with ease. If the armature is to be removed, the journal caps are taken off, the case supported from below, and a plank laid one end on the motor case and the other on a cross support in the pit; on this the armature is rolled out of its bearings, away from under the car and on to the floor. An armature can be taken from one of these motors very easily and quickly and with little danger of injury. All the screws and bolts are easily accessible, and may be removed with a socket wrench from the top.

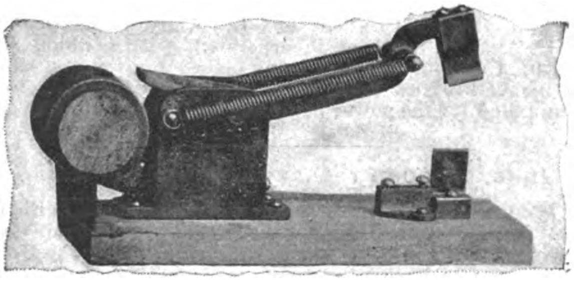
A novel attachment is the commutator turning device shown in position at the lower left hand corner of Fig. 2. By its means the case can be opened and the commutator turned off in no longer time than would be required to take the armature out and place it on the floor. When the motor case and armature are lowered, the pinion is released from the gear wheel and is used as a means for turning the armature. This is done with a leather belt making connection with the pulley and crank handle fastened to the case. The speed can be made anything desired, and as good a job of turning done as in a lathe. One attachment will answer for any number of motors.

The armature, field coils and commutator are carefully designed and skillfully made, and represent years of experience. The controlling stand shown in Fig. 3 is so simple that a few words will describe it. The operating handle is placed centrally on top of the cover and turns a short shaft from which motion is transmitted to another shaft, shown at the left, by means of two small sprocket wheels and a chain. Immediately under the cover is the reversing switch, the handle extending through the case at the right. On the longer shaft are placed eight cams, insulated from it by heavy, hard rubber tubing and secured by hard rubber pins. Opposite each cam is a switch fastened by a suitable bracket or base to the back near the shaft. Each switch is provided with contact pieces to engage with clips on binding blocks fastened to the back. At the bottom of the stand is a series of binding blocks for making connection between the controller, motor, resistance and line.



THE CARD ELECTRIC CAR CONTROLLER.

The operation of the controller switch will be clearly understood at a glance by reference to Fig. 4. The two springs fastened to the switch arm and the bracket back of the pivoting point, operate to throw the switch in or out when the cam has moved the arm in either direction past a centre line, and makes that motion independent of the operator and always at the same speed. The cam gives positive movement to the switch until it is just releasing from the contact clips, when the springs act and throw it quickly. The same thing occurs when contact is made, so that no matter how slow the movement of the handle may be, there can be no drawing out of arcs or burning of contacts. The reversing switch is of the simplest form with sliding contacts, and every part is accessible. The leading-in wires at the base are protected on all sides, and hook into their respective binding blocks where they are further secured by screws.



THE CARD CONTROLLER SWITCH.

The company has issued a well illustrated and clearly written catalogue of these motors and apparatus that will well repay careful reading.

THE CUMMINGS ELECTRIC CARRIAGE.

SINCE the recent description of this vehicle in THE ELECTRICAL ENGINEER, the inventor has made some further practical tests with a view to getting reliable data as to the probable operating expense. An invitation was recently tendered to several interested parties to investigate the actual power required to propel the carriage, and also to test the ease of steering and operating the device by inexperienced persons. A ten mile trip was made through the streets and boulevards to Washington Park, and a pleasant morning drive through the park was taken. During the greater part of the trip the carriage was operated solely by one who had never before handled the vehicle, and this without any specific instructions of any kind.

The average power required during the whole trip was less than 1¼ H. P., the ammeter varying from 22 amperes on smooth, level macadam roads to 49 amperes when ascending a slight grade, and the voltmeter showing 26 volts. The entire trip was made without a hitch of any kind and was voted a great success. There seemed to be no indications of weakness or unreliability of any part of the vehicle, and, as far as its suitability for pleasure travel on ordinary city streets or boulevards is concerned, it has every indication of being a marked step towards a successful solution of the problem of individually propelled vehicles.

THE AACHEN-BURTSCHEID ELECTRIC RAILWAY.

THE economy in operation which can be secured in generating current for electric railways at electric light stations is beginning to be recognized in Germany. In Hamburg, for instance, one quarter of the output of the electric lighting station is taken by the railway. Recently the city of Aachen decided to operate an electric railway, and to get its current supply from the electric light station erected by the Elektrizitäts-Aktiengesellschaft, formerly Schuckert & Co., of Nuremburg. The length of the first line to be constructed is about 15 miles, and suburban lines to be put in operation later will increase this distance to nearly 20 miles. The existing single track road will be replaced by a double track. The hilly nature of the city is somewhat unfavorable to traffic, grades of 5 per cent. are frequent and the maximum is 8 per cent. The trolley system will be employed. Of the 34 cars 19 will be equipped with 15 H. P. motors, which are expected to haul a trailer, and the rest will be equipped with 10 H. P. motors. The entire electrical work will be carried out by the Elektricitäts-Aktiengesellschaft, of Nuremburg, and will be similar to that installed in the road at Zwickau, and the one which will be shortly completed at Baden-Vöslau.

THE BELLEVILLE ELECTRIC RAILWAY.

Mr. W. C. Gotshall, who has recently completed and turned over to the company the electric railway system of Muncie, Ind., recently described in THE ELECTRICAL ENGINEER, has now taken up the Belleville Electric Railway, of Belleville, Ill. The enterprise contemplates eight miles of track in Belleville with an eighteen mile extension to St. Louis. The cars will pass through East St. Louis over the St. Louis bridge and stop at the foot of Third and Washington avenue. About five miles of the road in Belleville has already been completed.

NEW LONG DISTANCE RAILWAY WORK PROJECTED.

Reports from various parts of the country and abroad seem to indicate that there is considerable railway construction work either actually being done or under serious consideration. The Pennsylvania Traction Company is said to have in view the construction of a four track trolley road between Harrisburg and Philadelphia, a distance of about 100 miles, and it is proposed to have at least the greater portion of the road in operation in about a year. The route for the proposed electric line between Chestertown and Queenstown has also been surveyed. The line chosen will be about twenty-five miles long.

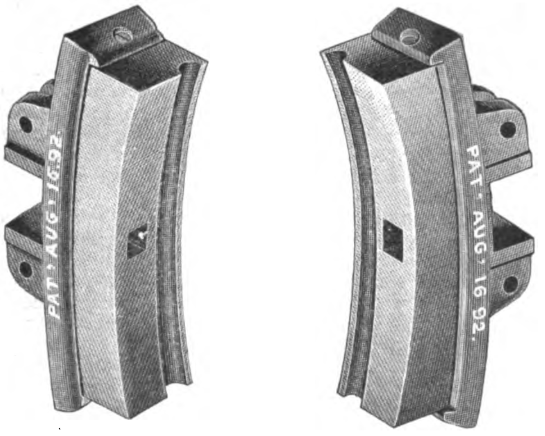
In California the Pasadena and Los Angeles Electric Railway Co., Los Angeles, has been incorporated, with a capital stock of $500,000. Contracts are now being placed for the first section of the Philadelphia-New York road, namely, Philadelphia to Trenton; and land for the power plant has been acquired at Bristol.

UNDERGROUND TROLLEY SCHEME IN CHICAGO.

A syndicate has been formed in Chicago to control the underground electric system for the propulsion of street railway cars. The system controlled by this company is that of the Universal Electric Co. which was exhibited and operated at Coney Island last summer, and fully described in The Electrical Engineer of July 5 and Oct. 18, 1893. The syndicate is composed of capitalists from New York, Chicago and New Orleans.

THE WHARTON WOODEN BRAKE SHOE.

The accompanying illustration shows a wooden faced brake shoe, made by Messrs. Wm. Wharton, Jr. & Co. (incorporated), of Twenty-fifth street and Washington avenue, Philadelphia, which, it is claimed, has developed under extensive service, qualities superior to metal. It is also said to be cheaper than metal after the first cost, and the renewal is confined to replacing the wooden block, as the iron hanger has no wear and lasts indefinitely. The renewal costs very little in labor, consisting of replacing the wooden block in the iron hanger instead of putting on the shoe and hanger together. The wood can be put in and taken out readily and runs no risk of displacement in service. The block is made of oak cut across the grain, thus exposing the ends of the fibres to wear, which prevents the tearing out of the ends and the sides, and presents a surface to the wheel which has greater tenacity than any metal.



The Wharton Wooden Brake Shoe.

These shoes are in use on a number of well known street railways whose managers are enthusiastic in their praise. The makers state that they have many samples which have run 6,000 miles, with average stops and quite heavy grades. They have patterns of shoes for all standard trucks, and will also make shoes of special designs to suit purchasers. Besides the wooden shoes, however, the company can supply those of mixed steel and iron or all iron, for those who prefer them.

THE SIOUX CITY TRACTION CO.

The Sioux City Traction Company, with a capital of $1,000,000, has arranged to succeed the Sioux City Street Railway Company in the ownership and operation of the forty miles of electric street railway which it got by foreclosure. The new company is composed of bondholders of the old. Of the stock, $630,000 was paid for in bonds and the balance in cash. D. L. Wright, E. F. Stone and J. C. French, of Sioux City, and M. L. Kohler and J. W. Harner, of Philadelphia, are the directors and corporators.

MISCELLANEOUS.

INSURANCE VIEWS ON ELECTRICITY AS A HAZARD.

The following is the comment of the *Insurance Herald*, of Louisville. Ky., on the colored charts recently published by the *New York Chronicle*, and is therefore interesting as showing that even among the insurance people, electricity has some critics neither unkind nor unfair :—

The extra number of the *Chronicle* containing careful diagrams of the causes of fire by classes for the year 1893 has been issued, and we have examined it with a great deal of interest for the purpose of discovering the havoc wrought by electric wires. There are a great many underwriters who believe in their souls that electric wires are destroying the world, and it is, perhaps, high testimony to the strict accuracy of the *Chronicle's* work that the diagrams do not show this to be the fact, even though it is a fad to attribute losses to the wires. The percentage of losses attributed to electric wires in the diagrams is noticeably small, in spite of the fact that in cities the maze of wires and the extent of lighting and power by electricity is increasing yearly. This percentage is not properly understood save in view of the fact that as one cause of harzard is increased by introduction, another is decreased by removal. Thus in thousands of theatres and opera houses electricity is used for lighting either in conjunction with the gas or without it. The electric lights have supplanted the dangers from gas jets to a greater or less extent. The diagrams show that in this class of risks in 1893, 12.5 per cent. of the fires were caused by electric wires and 11 per cent. by gas jets. Retail clothing houses show 11.5 per cent. of fires due to electric lighting and 12.5 caused by gas jets, while 11.5 per cent. were due to lamp explosions. Taking values into consideration, it is probable that an enormous excess of retail clothing stocks are in storehouses lighted by gas or electricity, yet electricity is chargeable with little more loss than oil lamps that explode. Even in the risks where electric wires might be expected to cause most damage, such as electric lighting stations and telegraph and telephone stations, the danger is not so great as is exhibited in other classes from other causes. In electric lighting stations the wires are charged with 30.5 per cent. of the fires. in telegraph and telephone stations with 62.5, while to cotton in transit 66.5 per cent. of the fires were caused by locomotive sparks. In both cases it is probable that many of the fires are attributed to these causes that may have originated otherwise. These suggestive causes are at hand, however, and the dog, having a bad name, gets the blow ; just as our old friend, "Matches." "Matches" looms up in the diagrams to an extent and frequency that puts electric wires to shame. The world seems to be really doomed for the use of matches, off which, we presume, rats are dining with their usual gluttony. If there was no match food manufactured for rats, we verily believe the loss ratio might be reduced to such a fragmentary minimum that fire underwriters could, in a year or two, take a holiday and throw money at birds.

POSTAL TELEGRAPH MORSE JUBILEE BANQUET.

We have been favored by the Postal Telegraph Cable Co. with a report of the "family" banquet with which that company and its officers, on May 24, in their fine new building on Broadway, celebrated the jubilee of the sending of the first message. Nearly 150 officers and employees of the postal and Commercial Cable Companies were present. Mr. John W. Mackay presided; and Mr. A. B. Chandler, president and general manager of the Postal, and Mr. George G. Ward, vice-president and general manager of the Commercial Cable, from their places on his right and left assisted him by acting as toastmasters. Mr. Mackay welcomed the gathering in his characteristically terse and modest way, and the welcome to himself, in response, was warm and hearty to a degree, evidencing the close ties that bind the Mackay interests together. Mr. Chandler then spoke with great eloquence of the memorable anniversary and of the evolution of the Postal system, out of a thing of shreds and patches into the compact highly organized institution of to-day. He also spoke gracefully of the beautiful building that now housed them, and expressed his faith in telegraphy as a career for many of the younger men he saw around him.

Next came Mr. George G. Ward in a sparkling speech on behalf of the Commercial cables. He mentioned the interesting fact that in 1891, upwards of 250,000 messages were exchanged between the Postal and Commercial Companies; in 1892, 270,000; in 1893, the panic year, 273,000; and that the amount per message accruing to the Postal averaged 41 cents, and that to the Commercial, $1.86. During 1893, no fewer than 9,000,000 words passed over their two Atlantic cables, with only one error in every 6,000 words. He closed with proposing the health of Mr. Mackay, which was received with tremendous cheers. Mr. Mackay's speech was modesty itself. He made more than one neat point, alluding to the occasion as "the anniversary of the most memorable event of the century," and addressing those before him as associated in "the development of the science that has changed the face of civilization." After more hearty cheering, Mr. John W. Mackay, Jr. made a brief address in a bright, enthusiastic way. The healths were then drunk of the President of the United States and of Queen Victoria; and then came a number of speeches by other officers, present from all parts of the world. It was quite late when the banquet ended, having proved a most enjoyable success. Never before in telegraphic circles had the owners and directors of a vast system sought to meet the representatives of every department on terms of equality and good will.

The morning of the 25th was spent at headquarters in an informal discussion of business matters and in the extension of personal acquaintance.

STORAGE BATTERY LIGHTING ON THE CHESAPEAKE & OHIO RAILROAD.

It is generally known that certain trains on the Chesapeake & Ohio R. R. have been lighted by storage battery for some months, and the experiment has now been carried far enough to enable one to draw some conclusions as to its practical success. Thirty-three cars are equipped, being eight coaches, eight combination cars, eight express cars, five dining cars and four postal cars. These run mostly in the service between New York and Cincinnati.

A comparative statement of cost of working and maintenance, including interest on the total investment, has been made for the General Manager. This comparison is between the 33 storage battery cars, 21 Pintsch gas cars and 187 cars lighted with kerosene oil. The comparison indicates that the cost of the electric lighting is about 13 per cent. less than that of lighting with Pintsch gas, and 70 per cent. more than that of lighting with oil lamps. We give these figures, however, says the *Railroad Gazette*, as being still quite uncertain, and are not yet so convinced of their accuracy as to venture to publish them in detail.

The system used is the Silvey storage battery already known to our readers. This battery is built up of lead grids laid horizontally, the positive and negative plates being separated by a special packing. These plates are cast with rectangular cells which hold the active material, and each pile is carried in a hard rubber jar.

The train unit of battery weighs about 600 lbs., and two of these units are called a set. These are carried underneath the middle of the car, the boxes which receive them being fastened to the framing and having end doors and being provided with rollers on the bottom, so that the boxes carrying the batteries may be conveniently slid in and out. An ordinary coach may be lighted for the run from New York to Cincinnati and back by two sets, that is, 2,400 pounds of battery, although the sleepers, the postal cars and the dining cars, and perhaps some of the coaches, carry three sets, say, 3,600 pounds. The battery gives 36 to 40 hours of lighting with 148.8 candle power in each car. As a matter of fact, the dining cars have sufficient current stored to last them five or six days, they often being recharged on the sixth day.

TELEPHONE SERVICE AT MESSAGE RATES.

The Metropolitan Telephone and Telegraph Co., N. Y., has established a new schedule of rates for telephone service which went into effect on June 1st. The present flat rates of $20 per month for business use and $18 per month for residence use will continue in force, and no existing contracts will be affected by the new rates, but those desiring telephone connection in future will have the option of paying for their service in proportion to the amount of service rendered. This method of charging, analogous to that which has long obtained with the supply of gas, water and electricity for lighting and power, will put the telephone service within the reach of many business men and householders who have hitherto felt that their probable use of the service would not justify the payment of the present flat rates. These, of course, are based on the average use of large and small users taken all together, and although the system is part of the history of the telephone business and has all the tenacity and solidity of a firmly rooted custom it obviously bears heavily on the small user. This customer will now have his wants catered to by the supply of telephone service at a minimum annual rate of $100 for a station on a two-station party line or $150 for a direct line. For the former rate the subscriber will be entitled to call for 700 connections in the year and for the latter 300 more. The rate per additional hundred connections begins at $12.00 and scales down to $7 as the number of messages contracted for annually increases.

These rates are for messages used in excess of those contracted for in advance. When the subscriber estimates his probable use and contracts in advance for a certain number of messages he gets them at $2 less per hundred all along the scale. For instance, a subscriber contracts for a direct line at $150, and is entitled to call for 1,000 connections during the year. If he runs over the 1,000 he will pay $10 for the next hundred, but if he contracts for 1,100 in advance he will pay only $8 for the additional 100 messages. If he does not use any of the additional hundred the $8 will be returned to him. There is an initial charge of $15 for installing a station.

The service will be of the same character as that now furnished, that is, metallic circuit lines and long distance instruments, and in every respect those who join the Metropolitan system under the new rates will be on exactly the same footing as the present subscribers, with the single exception of the method of paying for their services.

This innovation is to a certain extent an experiment on the part of the Metropolitan Company, undertaken in the light of the experience gained with the public telephone station traffic. With a view to catering to the occasional user of the telephone the company has, during the past year or two, very largely added to the number of its public "pay stations. There are now more than 1,000 of these stations scattered throughout New York City and from the use of them by "all sorts and conditions of men," there has arisen a distinct demand on the Metropolitan Company for a class of service which should be intermediate between the public pay station and the private telephone station at flat rates. The new system of rates provides exactly that. It gives a private telephone service on a pay station basis, with the simple business-like proviso of a minimum amount of use and a minimum rate.

We feel little doubt that this tentative step of the Metropolitan Company is in the right direction. It is made with all caution and prudence and the scheme contains nothing that can provoke unfavorable criticism or opposition on the part of present subscribers. There is no obligation on present or future subscribers to take either class of service. The actual subscriber can change to the message rate system if he wishes to, on the expiration of a contract in force, and the new subscriber can take service at the flat rate. We fancy that the majority of new subscribers will prefer to pay according to the new method. The strong point about it is that it brings telephone service within the reach of the small user.

Subjoined is the full schedule, taking effect June 1, 1894, for New York city, south of 110th street:

Number of Messages.	Two-Party Line.	Direct Line.	Excess Messages.
700	$100		$15.00 per 100
800	110		12.00 " "
900	120		12.00 " "
1,000	130	$150	12.00 " "
1,100	138	158	10.00 " "
1,200	146	166	10.00 " "
1,300	154	174	10.00 " "
1,400	161	181	9.00 " "
1,500	168	188	9.00 " "
1,600	175	195	9.00 " "
1,700	182	202	9.00 " "
1,800	188	208	8.00 " "
1,900	194	214	8.00 " "
2,000	200	220	8.00 " "

For more than 2,000 messages Direct Lines only will be used, and the rate of advance will be $5.00 per hundred, with $7.00 per hundred for excess messages.

For these rates, lines will be metallic circuit and equipped with long distance transmitters (wall or desk sets only). For a cabinet set (wall or desk) $10.00 per annum additional will be charged. An installation charge of $15.00 will be made for each station. Where an established station is brought under a Message-Rate contract, the installation charge will not be made.

ROSE POLYTECHNIC INSTITUTE.

The Rose Polytechnic Institute, at Terre Haute, Indiana, is one of the few endowed and thoroughly equipped colleges of the country devoted exclusively to the professional education of civil, mechanical and electrical engineers and chemists. Though one of the youngest of these institutions, perhaps none of them has met with greater success in filling the present demand for professional training in electricity, regarded as one of the branches of mechanical engineering. It has been able to do this by reason of a fortunate combination of circumstances, which developed its plan of instruction, and the purchase of its equipment just at the time that this public demand for electrical education became imperative.

While this plan insists upon and fully develops the theoretical side of the instruction, and includes the modern languages as well, it lays especial emphasis on the practical side of technical education, as it is able to do throughout the whole course of four years by reason of ample shops, drafting rooms and laboratories, and an exceptionally complete outfit of instruments of precision. The teaching force is so organized as to render shop practice most effective. It consists in addition to the ordinary faculty of instruction, of a body of skilled workmen, or shop instructors, whose entire time is devoted to regular shop routine with the students. This makes it possible for students not only to complete the designs for machinery in the drafting rooms, but to build it in the shops, and also to test it in the laboratories.

THE COMPTON ELECTRIC BASE BALL REPORTER.

Many efforts have been made from time to time, especially by the daily papers, making a specialty of sports, to give to the public who cannot leave town some idea of how the games and races are progressing at any moment. Everyone remembers the ball field diagram on which each day's game was shown in front of a newspaper office on Park Row, and that was ordered down because popular enthusiasm was so great as to completely block the street and prevent traffic. This very fact showed beyond a doubt that there was an opening for a device of the kind that should give all the points of the game as they occurred, and the inference was that people would be willing to pay for it as for any other legitimate amusement.

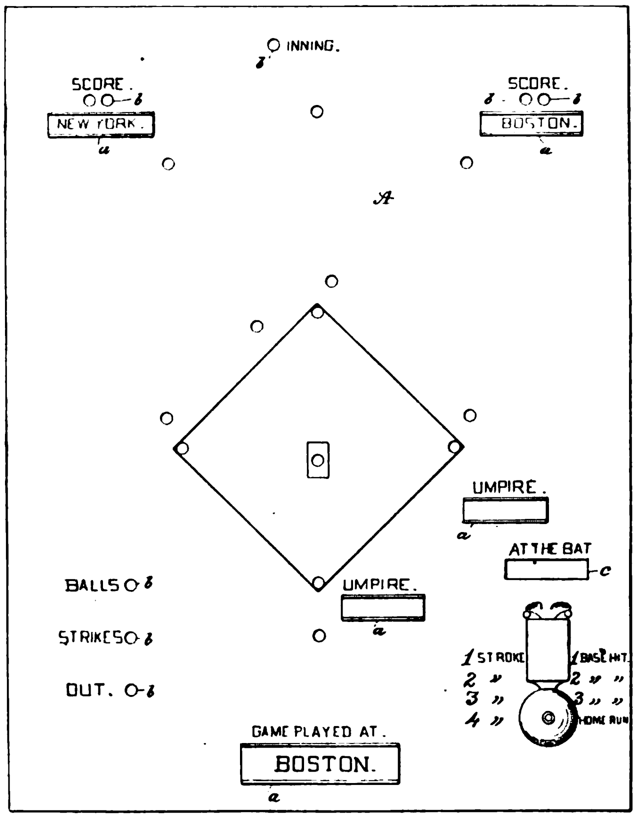


FIG. 1.—THE COMPTON ELECTRIC BASE BALL REPORTER.

A system more elaborate than any hitherto devised has, therefore, been perfected by Mr. Melvin D. Compton of this city and is now on daily exhibition at the Standard Theatre where it seems to arouse nearly the same enthusiasm as does the actual game. The mechanism is extremely simple and will be readily understood by reference to the accompanying diagram. Fig. 1 shows the "field." In reality this is made more life-like by being painted in perspective instead of being diagrammatic. The scene is very natural and the grand stand is as full of people as any manager could wish. The circular holes, with the exception of those marked *b* represent the position of the players and show by their color which side is at the bat and which in the field. Those representing the side in the field do not change during an inning, but the progress of a man running the bases is indicated effectively and amusingly. When the batsman hits a fair ball his number disappears from the home plate and there is an instant of suspense before one knows what has become of him. Should he succeed in reaching first base the picture of a man suddenly appears at that point, and, if New York is at the bat, the audience goes crazy at once. Should he be put out, however, it is shown by the number, 1, 2, or 3, as the case may be appearing in the aperture marked "out," in the left hand lower corner. The score, innings, man at bat, strikes, balls, etc., are indicated as shown in the figure.

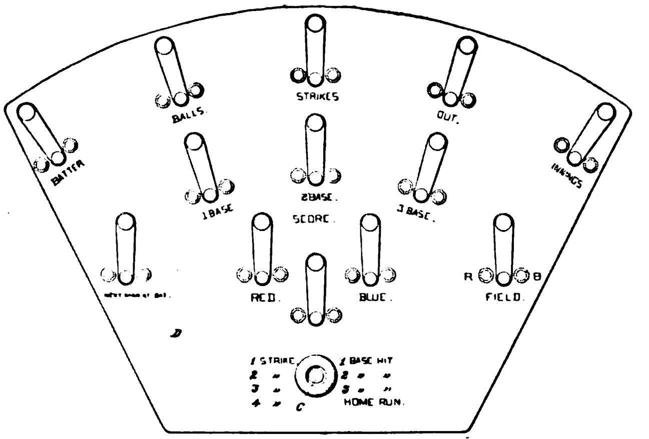


FIG. 3.—THE COMPTON BASEBALL REPORTER SWITCHBOARD.

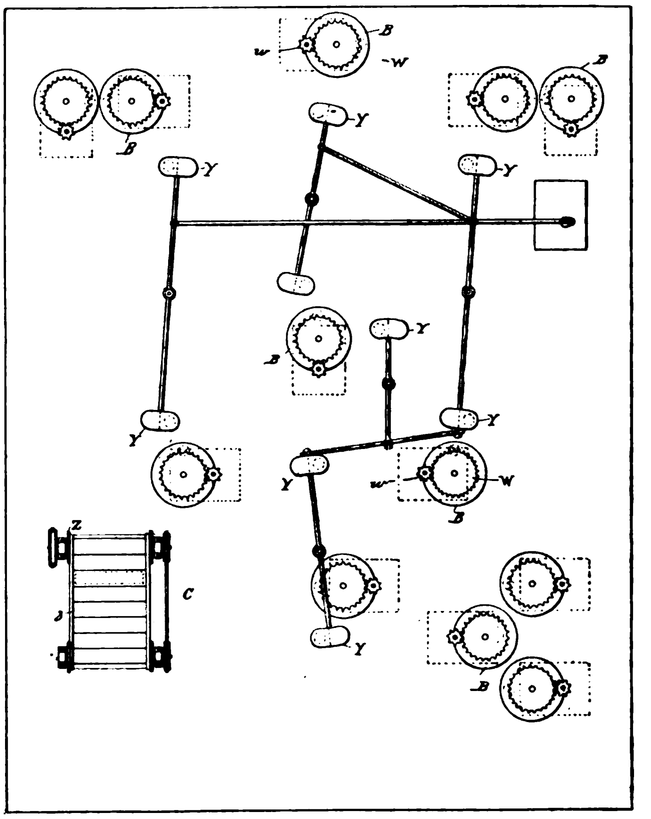


FIG. 2.—THE COMPTON ELECTRIC BASE BALL REPORTER.

The back of the flat, with the mechanism for making the changes is shown in Fig. 2. Each movement is effected by means of an independent electromagnetic motor with a vibrating armature similar to that of a call bell, that cuts itself out automatically at each half revolution, and everything is controlled from the switchboard, Fig. 3, the operator receiving the report of the game telegraphically by a private wire from the grounds, and simply making the changes as he receives his information. It will be seen that Figs. 1 and 2 correspond exactly in a reversed position; *i. e.*, if the page be folded so that the two are back to back they will occupy their true relationship to one another.

The same idea, somewhat modified, has been used in posting the official scores at the grounds.

LEGAL NOTES.

THE GETTYSBURG TROLLEY ROAD TO STAY.

In the United States Court in Philadelphia, the motion of the United States Government to enjoin the Gettysburg Electric Railway Company from building a branch trolley road on the Gettysburg battlefield was denied, and the motion dismissed.

SHAPLEIGH CUT-OUT NOT INFRINGED.

The Shapleigh suit was decided last week in the United States Circuit Court at Philadelphia by Judge Dallas. The suit was brought by Marshall Shapleigh of Pittsburgh, against the Chester Electric Light and Power Company to enjoin them from using a cut-out to prevent the burning out of incandescent lights when an excessive current is turned on. The cut-out in use by the Chester

Company, is manufactured by the Emerson Electric Light and Power Company of St. Louis, and Shapleigh claims that it is an infringement on his patent. Judge Dallas refused the injunction and dismissed the suit at the plaintiff's cost on the ground that no infringement was shown.

SOCIETY AND CLUB NOTES.

THE BROOKLYN ELECTRICAL SOCIETY.

"The Practical Construction of the Telephone" will be the subject of the next regular lecture of the Brooklyn Electrical Society which will be given on Thursday evening, June 7, at the residence of Mr. R. J. Simes, Jr., No. 26 Prospect Place, Brooklyn. The speaker will be Mr. Thomas A. Bamford, who will construct a telephone before his audience.

The Brooklyn Electrical Society which has recently been organized is composed of a number of young men who are interested in the practical uses of electricity. Many of them are graduates of the Pratt Institute Electrical Class of 1894 and the society was formed for the dissemination of knowledge among its members. Among the papers read recently were, "A Sketch on Underground and Overhead Electric Traction" and a well written paper on "Direct-Driven Generators."

Five consecutive papers on Electro-metallurgy will soon be read before the society; also an illustrated paper on "How to Build a Phonograph," besides illustrated talks on the telegraph and dynamo and other important electrical apparatus.

The meetings are at present held at the members' houses, but in the Fall the society will accept the offer of Manager William S. Barstow of the Edison Electric Illuminating Company's Station on Pearl street, Brooklyn, to use the Company's lecture room. Membership in this society is open to all interested in electricity.

The officers of the society are as follows: William C. Burling, president; William C. Otten, vice-president; Arthur A. Fisk, secretary and treasurer.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

THE monthly meeting of the western members of the Institute was held at Armour Institute, Chicago, on Wednesday evening, May 23. The meeting was even better attended than the preceding one, an interesting audience of over 125 being present.

Mr. B. J. Arnold being chosen chairman of the meeting introduced Mr. Alexander J. Wurts of Pittsburgh, who presented his paper on "Discriminating Lightning Arresters." The reading of the paper was supplemented by practical demonstrations with current, several very interesting experiments being performed by Mr. Wurts, many of them eliciting great applause. The chairman, with a few well chosen remarks, then called upon Mr. Arthur V. Abbott of the Chicago Telephone Co. to open the discussion, which proved very interesting and was participated in by Messrs. Pierce and Gutman, Prof. Stine, Dr. Lobach and others. Mr. C. C. Haskins being unable to attend, sent a very interesting communication relating his experience with lightning and lightning arresters in the early days of telegraphy, the communication being read by the honorary secretary, Mr. Caldwell. On motion of Mr. R. E. Pierce, which was carried unanimously, a vote of thanks was tendered Mr. Wurts, and on motion of secretary Caldwell a vote of thanks was given to Prof. Stine and assistants for their services during the lecture and for allowing the use of apparatus of the Armour Institute.

PERSONAL.

MR. E. J. WESSELS, who returned from Bermuda recently after a long sojourn there for the benefit of his health, has had the Genett air brake placed in his hands by the Seligman banking interests, to be pushed actively. This brake is peculiarly adapted to use on high speed electric cars, and Mr. Wessels' large acquaintance with the street railway field makes him a valuable man to represent it.

GAS ENGINES FOR ELECTRIC LIGHTING IN GERMANY.

MR. F. H. MASON, United States Consul General to Germany, states that there are in operation throughout Germany about 25,000 gas motors aggregating 80,000 horse power. He states that through the cheapening of gas, and the rapid extension of electric lighting and other applications of electricity, the use of gas motors has been very largely increased of late. As evidence of this, he states that the two principal makers of gas engines in Germany have alone made and delivered during the past two years 1,950 motors.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED MAY 29, 1894.

Accumulators:—

Element for Secondary Batteries, S. A. Rosenthal and V. C. Doubleday, London, Eng., 520.614. Filed Dec. 5, 1892.

Consists of a corrugated and perforated sheet of lead and an enclosing casing of non-conducting material in which the plate is firmly fastened.

Alarms and Signals:—

Safety System for Railroads, W. H. Elkins, Cambridge, Mass., 520,520. Filed Oct. 22, 1892.

An automatic electric block system for steam railways.

Fire Alarm Apparatus, F. J. Thunhorst, Allegheny, Pa., 520,547. Filed Feb. 26, 1894.

Electric Railway Signal, C. Selden and H. V. Riley, Baltimore, Md., 520,661. Filed Feb. 16, 1894.

An automatic visual electric block system for steam railways.

Electric Railway Signal, C. Selden and H. V. Riley, Baltimore, Md., 520,710. Filed Feb. 16, 1894.

Similar to No. 520,661.

Conductors, Conduits and Insulators:—

Insulator, C. E. Conover, Cincinnati, O., 520.412. Filed May 20, 1893.

Insulator, H. H. Luscomb, Hartford, Conn., 520,602. Filed March 19, 1894.

Consists of a metallic case containing insulating material and having its lower edge turned upward as a protection to the latter.

Insulator, L. McCarthy, Boston, Mass., 520,606. Filed Sept. 23, 1892.

Consists of a metallic case and a metallic pin separated one from another by insulating material and a layer of the latter over the whole.

Dynamos and Motors:—

Alternating Current Motor, W. Stanley, Jr., Pittsfield, Mass., 520,620. Filed Feb. 1, 1894.

Employs a compensating synchronous motor, means for mechanically connecting it with an alternating current working motor and connections between both motors and the supply circuit.

Method of Operating Electric Motors, J. S. Bancroft, Philadelphia, Pa., 520,748. Filed Dec. 10, 1892.

Employs a rheostat regulating the admission of current to the field of the generator, a similar switch admitting a constant potential current to the field of the motor, and an interlocking between the two switch levers.

Galvanic and Thermo-Electric Batteries:—

Electric Battery, S. H. Hoggson, St. Louis, Mo., 520,429. Filed Mch. 6, 1893.

Employs cells arranged in a vertical series and electrically connected.

Miscellaneous:—

Electric Cigar Lighter, D. Misell, New York, 520,445. Filed Dec. 5, 1893.

Electric Clock Striking Mechanism, C. D. Warner, Ansonia, Conn, 520,585. Filed Apl. 6, 1893.

Therapeutic Electrode, W. B. Farrar, Greensborough, N. C., 520,673. Filed Apl. 5, 1894.

Railways and Appliances:—

Trolley Wire Support, B. J. Jones, Sioux City, Iowa, 520,737. Filed Feb. 5, 1894.

Consists of a supporting piece of triangular form adapted to fit a bend in the trolley wire and having its outer surface in the same horizontal plane with that of the remainder of the wire.

Conduit Railway Trolley, W. Lawrence, New York, 520,758. Filed Aug. 17, 1892.

Switches and Cut-Outs:—

Circuit Closer, G. W. Hey, Syracuse, N. Y., 520,427. Filed Mch. 11, 1893.

Switch, H. P. Ball, Bridgeport, Conn., 520,474. Filed Mch. 12, 1894.

A jack-knife switch composed wholly of sheet metal, the fixed blades formed of single strips of conducting material bent to form contact for the circuit wires.

Telephones and Apparatus:—

Magneto Telephone, A. F. Boardman, Somerville, Mass., 520,406. Filed Mch. 24, 1894.

Employs a permanent ring magnet and a clamping bar of non-magnetic material secured at its middle to the casing and with its ends engaging the ring magnet.

Speaking Attachment for Telephones, W. Weber, Philadelphia, Pa. Filed Feb. 15, 1894.

A flexible speaking tube one end of which is attached to the telephone transmitter and the other end carrying a mouth piece and an arm to support the receiver.

Testing System for Multiple Switchboards, C. E. Scribner, Chicago, Ill., 520,543. Filed Aug. 24, 1891.

Has for its object to provide a test signal of such a character as to be readily distinguishable from false signals produced by accidental causes.

LITERATURE.

Proceedings of the Electrical Society of Cornell University, 1893–1894.

THIS volume of 93 large octavo pages contains a selection of ten papers read before the society ranging over a wide scope of topics in both the practical and theoretical branches of electricity. All the papers show careful preparation and contain much information of value. Those on "Notes on Some of the Work of Nikola Tesla," by E. B. Clark, and "The Tesla High Frequency Phenomena," by R. W. Quick, are of more than ordinary interest and show an excellent grasp of the subject, indeed far beyond what one would expect in undergraduates. If the society maintains the high standard established by the contents of its first publication it may well hope to realize the expectations of its president, Mr. E. B. Clark, that it "will rank among the foremost engineering societies in American universities."

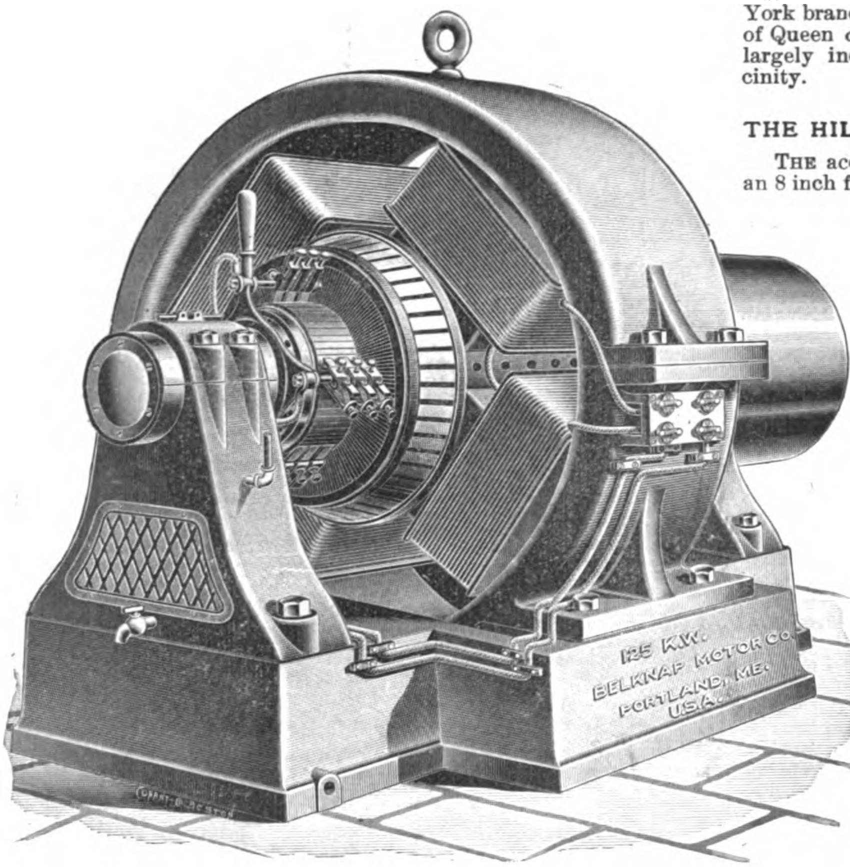
Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

THE BELKNAP MULTIPOLAR GENERATOR.

The Belknap Motor Co., of Portland, Maine, is one of the concerns that is crowded with orders and, notwithstanding the hard times, is building a large addition to its factory preparatory to going into the manufacture of large railway generators and motors.

The accompanying illustration shows the new Belknap multipolar generator which this enterprising company has just put on the market. The frame of the machine is made up of several parts, making it convenient to handle. The total weight is quite uniformly divided between the several parts, as shown, making a very convenient machine to set up in stations which are not provided with apparatus for lifting very heavy weights. The bed is planed to fit iron slides and is very rigidly constructed so as to withstand the strain brought on it by the weight of the field magnet. The magnet consists of two iron castings, the two together forming a complete circle with four inward projecting cores to receive the field coils. The magnet is bored and fitted with a pole bushing surrounding the armature, which gives the greatest possible effective polar arc. This prevents the disagreeable humming sometimes observed with toothed armatures under heavy loads and suppresses the tendency to spark by reason of stray lines of force.


125 K.W.
BELKNAP MOTOR CO.
PORTLAND, ME.
U.S.A.

The Belknap Multipolar Generator.

The armature is of the toothed hollow drum type. By a system of end connections, the crossing of the conductors at the leads of the armature is avoided, which reduces the danger of burn-outs, and every wire can be got at conveniently. The commutator is massive and the well-known Belknap woven wire and graphite brushes are used. The bearings are very large and are self-aligning and self-oiling. The two terminals are located at opposite sides of the machine to avoid the danger of a short circuit. The field cores are compound wound and the magnetic circuit of the machine is carefully designed with reference to the reluctance of cast iron, wrought iron and air so as to get the best attainable effect from the materials used. Such a machine should find a ready market.

ENGINE WORKS DRIVEN BY ELECTRIC POWER.

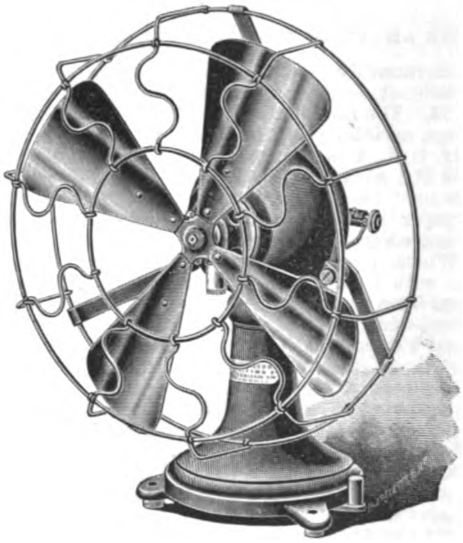
Last week the main shaft broke near the source of the driving power at the works of the American Engine Co., Bound Brook, N. J. Fortunately a Loomis multipolar generator was available and as its speed was only 820 revs. per min. it was belted directly to the shaft at a point just beyond the break and current was supplied to it by the regular lighting system which was driven by the engine independently. In a few hours everything was humming along as merrily as ever, all the power being furnished by electricity.

QUEEN & CO. IN NEW YORK.

The many friends of Mr. G. S. Woolman, so many years engaged in the scientific instrument business at 116 Fulton St., New York, will be interested to learn of a very important change in his affairs. The firm of Queen & Co., of Philadelphia, with whom he was connected earlier in life, having found it necessary owing to the great volume of their business in the vicinity of New York to establish a branch there, have purchased Mr. Woolman's entire business and have secured his services as their New York manager. From the Philadelphia staff of the Electrical Department, Mr. O. T. Louis, formerly in charge of resistance standardization in Queen & Co.'s laboratory at Ardmore, has been detached and stationed at the New York office. The establishment of this New York branch will be a great convenience to the many customers of Queen & Co., in New York and will undoubtedly result in largely increasing their already extensive business in that vicinity.

THE HILLHOUSE PRIMARY BATTERY FAN MOTOR.

The accompanying illustration shows a small fan motor with an 8 inch fan recently introduced by Messrs. Hillhouse & Co., of 136 Liberty street, and designed to take current from a primary battery. It is extremely simple in construction and runs at a high rate of speed on Edison-Lalande, Premier-De Mott and all wet or dry open circuit batteries, as well as upon all closed circuit batteries, requiring only about 1 volt and a little less than 1 ampere.



The Hillhouse Primary Battery Fan Motor.

Such an outfit as this should prove especially valuable in offices or private houses not wired for electric lighting. It is made by the Armature Bell Co., of Newark, N. J.

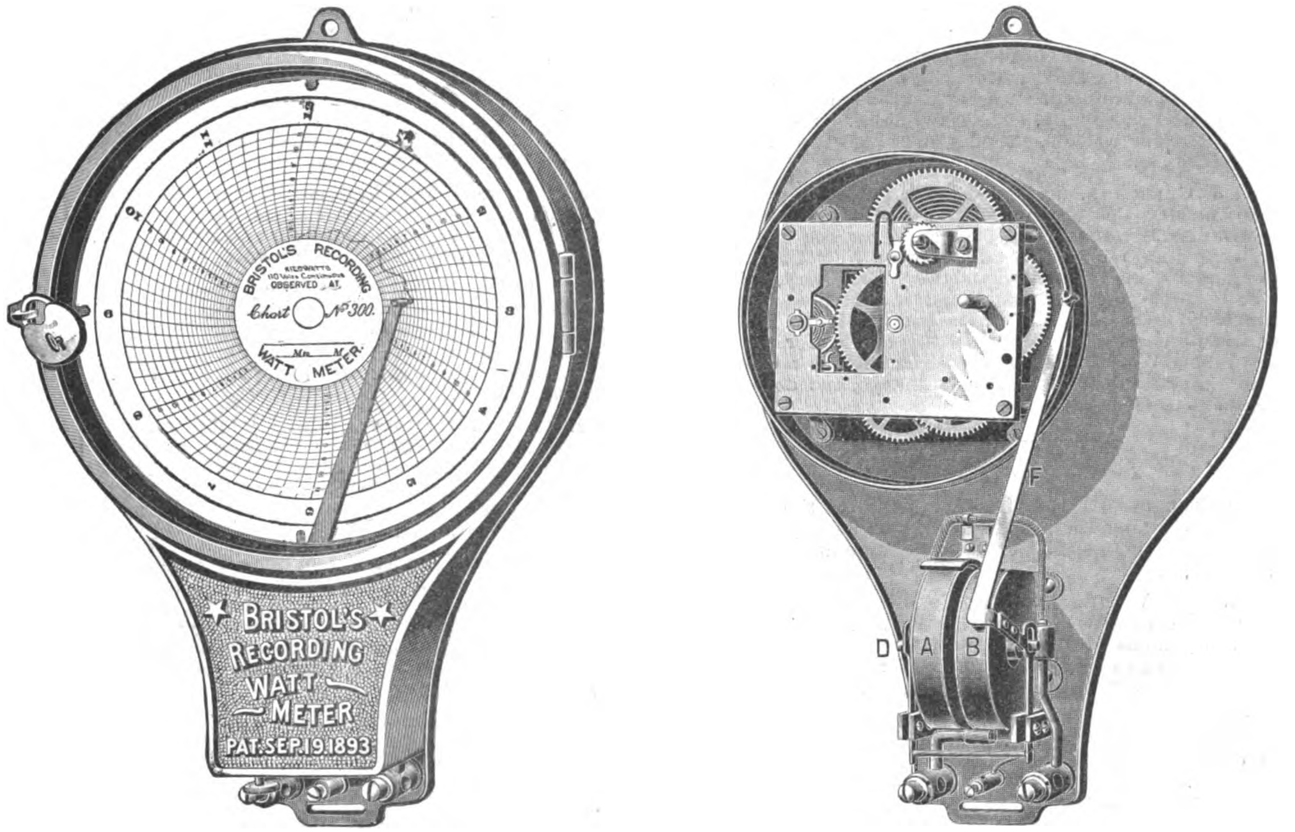
A REVIVAL OF WORK AT THE BALL & WOOD ENGINE WORKS.

The business of the Ball & Wood Company has so far recovered from the general business depression that they find it necessary to increase their force by the addition of a night gang. Beginning to-day, their works at Elizabeth, N. J., will be run to their full capacity, twenty-four hours a day, which speaks well for one of Elizabeth's youngest industries and for the reputation of the company's engines. By a singular coincidence it is exactly one year ago that the night gang was laid off in this establishment.

BRISTOL'S RECORDING WATTMETER.

THE accompanying engravings illustrate a new recording wattmeter that is being manufactured and introduced by The Bristol Company of Waterbury, Conn., to supplement their present line of recording voltmeters. The general design of the wattmeter is the same as that of the voltmeter, the principal modification being that a coil wound with a heavy conductor is substituted for one of the stationary coils of fine wire. This method of adapting the recording voltmeter to a recording dynamometer or wattmeter was planned for and fully described in the specifications of the patent of the voltmeter.

Referring to the engravings, Fig. 1 shows the instrument complete ready for connection; Fig. 2 shows the interior construction and manner of operation. The coil A, wound with fine wire, is mounted on spring knife-edge supports and is free to move toward the stationary coil B, which is wound with a heavy conductor capable of carrying the entire current to be measured. The terminals of the coil A are connected to the positive and negative conductors, and the magnetic effect of the current through this coil of high resistance will be dependent upon the voltage, while the magnetic effect of the main current through the coil B of low resistance will depend upon the number of amperes passing. The mutual attraction of the coils will be the product of these magnetic forces and proportional to the number of watts. The marking arm F is attached directly to one of the knife-edge spring supports of the movable coil and partakes of its motion, recording the variations of electrical energy on a uniformly revolving chart.



FIGS. 1 AND 2.—BRISTOL'S RECORDING WATTMETER.

While the actual motion of the coil is quite small it will be seen that the angular motion of the pen arm affords a sufficiently open scale on the chart without resort to ordinary multiplying mechanism which would introduce friction. As the only bearings in the instrument are the knife-edge supports of the movable coil it is extremely sensitive to the smallest changes of current. The magnetic balance principle involved in the construction makes it possible to entirely avoid the use of permanent magnets.

The divisions on the chart shown are kilowatts with a total range of eleven kilowatts. The stationary coil is designed for a maximum current of one hundred amperes. For larger currents proportional shunts are employed.

AN ELECTRIC FLEET FOR BOSTON.

The parks of the city of Boston are to be equipped with a fleet of about 250 boats, including a number of electric launches, which are to be charged from the Edison circuits. Gen. C. H. Barney is to be commodore of the fleet.

ACTIVITY OF THE ELECTRICAL AND MECHANICAL ENGINEERING AND TRADING CO.

A LITTLE more than a year ago, Mr. J. H. Vail organized the Electrical and Mechanical Engineering and Trading Co. The company now have in hand a variety of business, among which may be mentioned the following: Contract for car house, cars, motors, trucks and generators for Hoosick Railway Co., Hoosick Falls, N. Y.; contract for an electric light station and complete equipment at Rumsen Neck, N. J., for the Rumsen Improvement Co.; contract for electric lighting in new addition to Buckingham Hotel, New York city; contract for underground conduit system, telephone system and electrical conductors for J. C. Hoagland and Raymond Hoagland, Rumsen Neck, N. J.; consulting engineers for Trinidad Electric Light and Power Co., Port of Spain, Trinidad; contract for electric lighting system, underground conduits, pole line, etc., for Edward Kemp, Esq., Rumsen Neck, N. J.; supervising and consulting engineers for Poughkeepsie city and Wappingers Falls Electric Railway Co. This railway system will require a 600 h. p. steam plant, compound condensing engines and direct driven generators; there will be some fine long distance work, as one section of the road extends ten miles to the towns of Wappingers Falls and New Hamburgh, operating cars in and between both towns. The plant will incorporate Stirling boilers, compound condensing Ball & Wood engines, direct driven General Electric generators and "G. E. 800" motors.

Mr. Vail gives all the business of his company his personal attention, and turns out none but the best of engineering and construction. The company have pleasant and commodious offices at 39 Cortlandt street, where may be found some of the most expert and experienced engineers engaged in the business.

OERLIKON ALTERNATORS WITH STATIONARY ARMATURES.

WE have received from the Maschinenfabrik Oerlikon bei Zürich, Switzerland, an illustrated catalogue of their alternating generators for lighting and power. These machines are built in sizes from 20 to 700 H. P., and are characterized by a stationary armature with revolving field magnets. These alternators are built to deliver single or three-phase currents up to 5,000 volts potential and give high efficiencies, only from .2 to .8 per cent. of the total power being required for the field excitation. These alternators are built both with horizontal and vertical shafts for direct connection with turbines. It will be recalled that an Oerlikon Machine was employed to generate the three-phase current in the celebrated Frankfort-Lauffen transmission. The works also build a large variety of motors of the alternating type.

THE MEDBERY INSULATION.

The Mason Electric Co., W. R. Mason, general manager, Pullman Building, Chicago, has taken up the Western selling agency for the Medbery insulation and will push that well known and useful material, which is now so largely used especially in electric railway work, where the requirements are very exacting.

NEW YORK NOTES.

The Chloride Accumulator has been adopted for the Edison Kinetoscope, after an elaborate series of tests lasting six months.

Mr. Avery P. Eckert has severed his connection with Mr. W. R. Brixey, manufacturer of the Kerite wires and cables, and is now associated with the Safety Insulated Wire & Cable Co., of 234 W. 29th street, this city.

The General Electric Company has closed the contract for the Poughkeepsie & Wappingers Falls Railway of Poughkeepsie, covering two 200 kw. direct connected generators, 40 G. E. 800 motors and type K controllers.

Governor Flower has signed an important measure allowing New York electric companies, without reincorporating, to run a street surface railroad of twenty miles in length by complying with the provisions of the railroad law.

The Imperial Mfg. Co. formerly of 143 Liberty St. has been absorbed by The Newton Electric Co. of 49 Cortlandt St., who will in the future manufacture switches, cut-outs and all the specialties made by the former company. The Newton Co. have been very successful with their sockets, cut-outs, pole indicators and other electrical appliances.

Mr. W. J. Creelman, until recently the Philadelphia Agent for the Stearns Mfg. Co., of Erie, Pa., has just opened an office in the new Granite Building, Rochester, N. Y. for the sale of the Company's product in Western and Central New York. Their leading engine for electrical work is the "Woodbury," which is built in both simple and compound, and several have been built direct-connected to the dynamo on the engine shaft. Mr. Creelman has also been appointed Agent in this district for the Philaphia Engineering Works, Ltd., and will handle their Corliss engines, and self-sustained steel plate chimneys, and do a general steam engineering business.

NEW ENGLAND NOTES.

American Circular Loom Co.—The offices of the American Circular Loom Co. have been removed to their factory, Highland and Suffolk Sts., Chelsea, Mass. Their postal address is Chelsea Station, Boston, Mass.

The Davidson Ventilating Fan Co., of Boston, have made arrangements with the Wenstrom Electric Co., of Baltimore, to handle their dynamos and motors exclusively in New England. This company will now be able to compete for all electric lighting contracts in addition to their regular business of ventilating fan machinery and motors.

The Electrical Association, Inc., of Waterbury, Conn. have placed the contract for their new power station with the Berlin Iron Bridge Co., of East Berlin, Conn. The building will be 66 ft. in width and 183 ft. in length, the side walls of brick, and the roof covered with The Berlin Iron Bridge Company's patent anti-condensation corrugated iron roof covering.

Mr. L. C. Whitney, late manager of the New Britain Electric Light Company, of New Britain, Conn., has resigned his position with that company and is now connected as a special agent with the Royal Arc Electric Company of New York. Mr. Whitney's long experience as a central station manager will make him a valuable acquisition to the Royal Arc Co., and the fact that he has joined this company is a good endorsement of the value of their system.

The W. S. Hill Electric Co., of Boston, has shipped during the present month two consignments of switches to one electric railway company that weighed over eleven tons, and notwithstanding the unprecedented hard times, so great a demand have they created for their goods by the excellence of the work which they turn out, that their gross sales for the past eight months average more than 60% greater than for the corresponding months a year ago. Quality will tell in the long run.

The Mather Electric Company, of Manchester, Conn., are bringing out a new type of railway generator of large capacity, with complete station equipment, of entirely new and original design, and embodying a number of very important improvements in this class of apparatus. A detailed description of these new generators will be published shortly. The Mather Electric Company have secured a number of contracts for future delivery for these new large generators on some of the most important electric railways in this country.

The Beacon Vacuum Pump and Electrical Co. have recently secured the contracts for incandescent lamps for the Postal Telegraph Building and the Mutual Reserve Fund Building in New York city. They report business very much increased and are making now 3,000 to 4,000 lamps a day. It is interesting to note that they are now putting on the market their new 32 and 50 candlepower lamps, of all voltages the same as formerly. They are also commencing to turn out their well known anchored filament lamps at 27½ cents each in barrel lots, and have lately largely increased their factory to accommodate this branch of their work. They are also making their regular lamps in all the different colors of glass, with the colors solidly fixed, so that there is no danger of changing after being in use for some time.

Almon & Sargent, of Boston and New York, electrical engineers and contractors, have recently filled orders from the North River Electric Light & Power Co. for six Class B., L. P. & D. power transmitters, to be used in their New York city station, and also for two Class B transmitters, for the Pelton Water Wheel Co. to be used at Jackson, N. H. They have also received orders from Marr & Gordon, Barre, Vt. for one 30 h. p. generator and one 25 h. p. motor to be used in transmitting their surplus water power at their polishing works to their stone sheds, a distance of two and one-half miles, and have the contract for the construction. They are nearing the completion of wiring the fountain in St. Albans, Vt. for electric lights which when completed will form a very beautiful and interesting piece of electrical work.

WESTERN NOTES.

Mr. H. M. Grant, Gen'l manager of the Vulcanized Fibre Co., was in Chicago several days last week.

Mr. Wm. Fay, Gen'l Manager of the Dundee Rapid Transit Co., Elgin, Ill., was in Chicago last week contracting for additional material for their new light and power plant, which they intend to have ready for operation within sixty days.

Mr. John R. Markle has been appointed manager of the Western Department of the Electric Storage Battery Co. of Philadelphia, manufacturers of the Chloride accumulator. He has his headquarters in the Manhattan Building, Chicago. Mr. Markle's energy, push and ripe electrical experience qualify him admirably for his new duties.

Mr. Chas. E. Gregory, Chicago, is about to issue the fourth edition of his *Vest Pocket Telephone Directory* of electrical firms in Chicago. All who are engaged in electrical or kindred interests should at once send their names and telephone number to Mr. Gregory, so that they may be correctly reported in this handy and convenient volume.

The Hartley Electrical Works, is a new firm in Chicago, having been just started under the management of Mr. B. Hartley, a gentleman long and favorably known as superintendent of the winding department of one of the largest electrical concerns in the country. The firm will do electrical repair work of all kinds, making a specialty of rewinding armatures and repairing transformers.

The Mosher Electric Co., Chicago, is now owned and controlled by Mr. A. Weinberg, who has acquired all of the interests of Messrs. Reiman & Sheriffs. Mr. Weinberg was formerly treasurer of the Adams Westlake Co. and is exceptionally well qualified to take care of the large and growing interests of the Mosher Company. He will at once assume the active management of the concern. Mr. Mosher will continue with the company as electrician.

The F. P. Little Electric Construction & Supply Co. have opened a Chicago office at 186–188 Fifth avenue, in charge of Mr. W. E. Parker, formerly superintendent of their factory, who will make a specialty of handling the company's arc lamps, which they are so successfully introducing in the East. With his intimate knowledge of the business he will no doubt find it an easy matter to successfully exploit these lamps as well as the company's other business in the West.

The McLean Armature Works, Chicago, which started two years ago as the firm of McLean & Schmidt, has recently been reorganized, Messrs. Geo. T. Heald, formerly treasurer of the American Bronze Co., and John S. Parmele, for the past four years with the Great Western Manufacturing Co., becoming associated with the firm. Both are bright, energetic business men, and with the combined effort of them and Mr. McLean, the senior member of the firm, their business is bound to prosper.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.
Vol. XVII. JUNE 13, 1894. No. 319.

THE STANLEY ELECTRIC CO.'S NEW TWO-PHASE ALTERNATING APPARATUS.

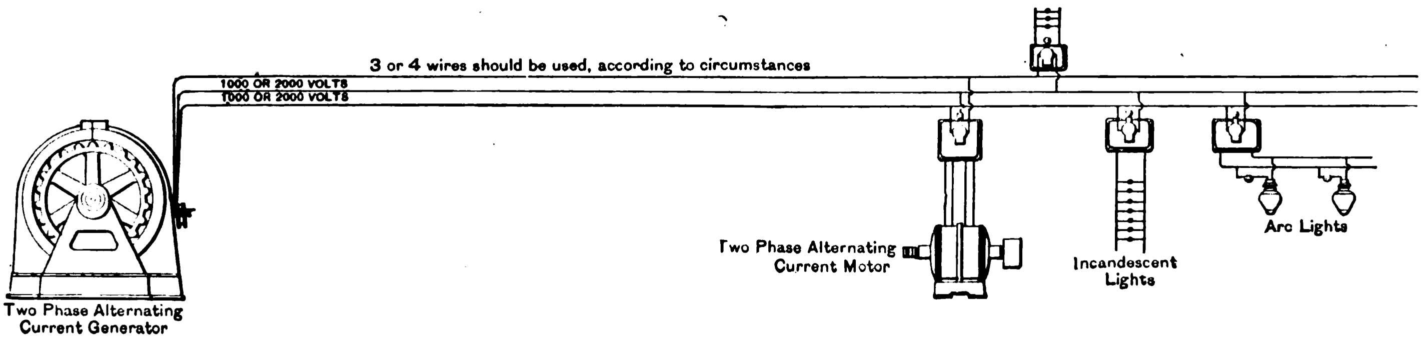

3 or 4 wires should be used, according to circumstances
1000 OR 2000 VOLTS
1000 OR 2000 VOLTS
Two Phase Alternating Current Generator
Two Phase Alternating Current Motor
Incandescent Lights
Arc Lights

Diagram of Two-Phase Circuits for Combined Lighting and Power.

IF one were to ask the question, How should an ideal central station be equipped, the answers might vary in certain details according to individual predilections but it is probable that the general consensus of opinion would tend towards a station having dynamos of one type, preferably uniform in size, which deliver current adapted to any kind of service, whether incandescent lighting, arc lighting or power at any distance from the station. Probably few stations if any to-day are equipped to render such service and hence it becomes worth while to inquire in how far such an ideal condition can be realized without too great a sacrifice which the abandonment of apparatus now in operation would entail.

Up to the present time the alternating current system owing to its great flexibility has probably afforded the nearest approach to the realization of the ideal condition, but the one important factor, the motor, has not until recently justified the hopes of its advocates. It was with this condition of affairs in mind that the Stanley Electric Co., of Pittsfield, Mass., set themselves the following task:

First, To produce a system which would admit of economical and satisfactory service of light and power from the same alternating current generator and circuit, and at the same time a system of such a character that existing lighting companies could operate it in connection with their present apparatus without necessitating the discarding of generators, transformers, etc., which represent a large investment. Second, To produce a system which would make it possible for those just starting in the business to equip a station with one class of apparatus for all purposes, so as to avoid the multiplication of apparatus and circuits necessary in the past where it has been desirable to furnish incandescent lights, arc lights and power. Third, To make possible the commercial transmission of the energy of water powers over long distances and its distribution for lighting and power purposes by a simple system not requiring the many conversions, and consequent wastefulness, and the duplication of apparatus made necessary by systems now in use.

To bring such a system into practical being has been the work of the electricians of the company, Messrs. Wm. Stanley, Jr., John F. Kelly and C. C. Chesney, and we propose to give in the following a brief outline of the principal types of apparatus employed to effect the desired ends.

It is safe to say that, in the majority of towns of average size, more money can be made by furnishing power than light, because as a rule, the power service is fairly steady for from eight to ten hours out of the twenty-four, whereas the maximum lighting service averages only three to four hours.

The multiphase system of distribution allows of furnishing both these classes of service in the most economical manner. One great advantage of the two phase generator is that it is fully as good and as simple for lighting purposes as the single phase machine. It can be used interchangeably with the latter, and, in fact, "dove-tails" in with existing systems just as well as new single phase generators, and is perfectly adapted for use on currents of the same frequency as the existing lighting circuits, that is, 15,000 to 16,000 alternations, so that to avail one's self of the advantages of the two phase system does not necessitate changing the present lighting transformers in order to secure economical conditions of operation.

By adding the two phase generators to its present equipment and by combining two existing circuits in a most simple way at the station switchboard, or by putting up one or two more small line wires, a station can equip itself for furnishing power and lighting indiscriminately in the daytime, and, when the hours of power service are over, the two phase machine can be run on two or more of the ordinary two-wire single phase circuits just as well as one or two of the old single phase machines.

A most important element in such a system however is regulation, so that, as motors are started and stopped or their load increased or decreased, lights on the same circuit will remain practically uniform and not be made to flicker. Owing to the heavy false currents often attending the use of the alternating current motors, such regulation has in the past been difficult, because, on this account, not only have the motors required excessive currents on light loads, thus drawing heavily on transformer, line and generator, but these false currents also have the effect of demagnetizing the transformer and generator, thus reducing the E. M. F. on the whole system and causing serious fluctuations in the lights.

For very long distance transmission, there are good reasons for using a lower frequency than the standard heretofore used in this country, but millions of dollars are now invested in apparatus of this frequency, and apparatus of a much lower frequency can not be grafted on to these existing plants and operated in connection with them economically. Instead of adopting a low frequency, therefore, Messrs. Stanley, Kelly and Chesney have supplied methods of eliminating these false currents, even where the high frequency of 133 periods per second (16,000 alternations) is used. One of these methods will be fully described further on. Another important consideration in this connection is the fact that the inherent regulation of a well designed alternating current generator is impaired in direct proportion as the frequency is reduced. That is, if the regulation of a machine of a given weight, speed and efficiency is 6 per cent. at 16,000 alternations, it will be 12 per cent. at 8,000.

The Stanley Company's position therefore, on this question of frequency is, where existing stations already have a large investment in alternating apparatus, to increase this equipment with two phase apparatus of the same frequency. Where, on the other hand, a new station is to be established, a frequency is adopted which will give the best all around economy, considering the loss in the line and the first cost and economy of operation of transformers.

The Stanley company builds its standard generators of 16,000 and 8,000 alternations, and motors for either frequency, and the type of the generators is such as to enable them to be made of the same speed for either frequency.

This generator is shown in Figs. 1 and 2, which represent machines of 240 and of 60 kilowatts respectively. The electrical design is the same in both, though the two require different treatment in regard to mechanical construction. The revolving field, more properly called in this instance the inductor, is made of a steel casting upon the periphery of which polar projections of iron laminæ are securely fastened. There is no wire whatever on it and consequently there are no band wires to break, no necessity for insulation and no use for a collector. The inductor is well shown in Fig. 3.

The armature is shown in Fig. 4. As will be seen it is made up of laminæ of iron and is stationary, constituting, in fact, the body of the machine. The individual coils are very small, wound separately on forms and then secured in grooves provided for them in the laminations. Being so small and stationary it is a comparatively simple matter to insulate them to safely withstand high pressures. If a coil should be destroyed by lightning, or any other cause, it can be readily replaced by the ordinary men employed about a station. This does not require disturbing the inductor at all, which when the machine is opened, simply hangs in its place in the bearings, and no special tools or appliances are necessary to insert a new coil.

The armature and field wires are brought out from the machine to a terminal board and from this the leads are taken out; with this arrangement no wires of any kind appear about the machine. The terminal board consists of two heavy slabs of marble, one secured to the machine and

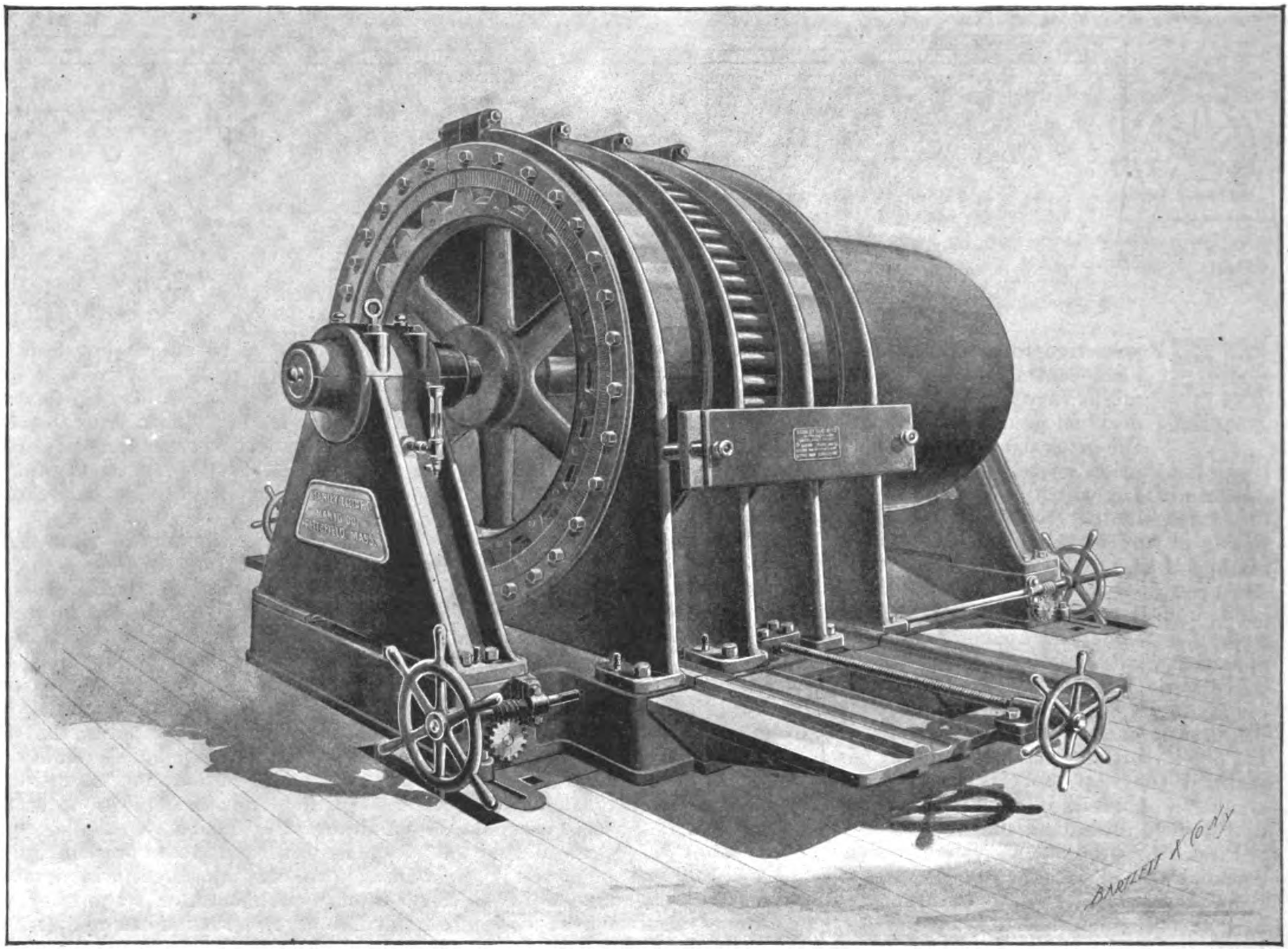

BARTLETT & CO.

FIG. 1.—THE STANLEY ELECTRIC CO. 240 KW. TWO-PHASE ALTERNATING GENERATOR.

the other forming a removable cover. This cover on its inner face is divided into partitions so that, when in place, each terminal is in a compartment by itself. It is so arranged that fuses may be inserted in the leads, if desired as an extra precaution against short circuits. By simply changing the connections on this terminal board the armature coils may be connected either in series or parallel, so that the standard machines may be connected for either 1,000 or 2,000 volts as desired.

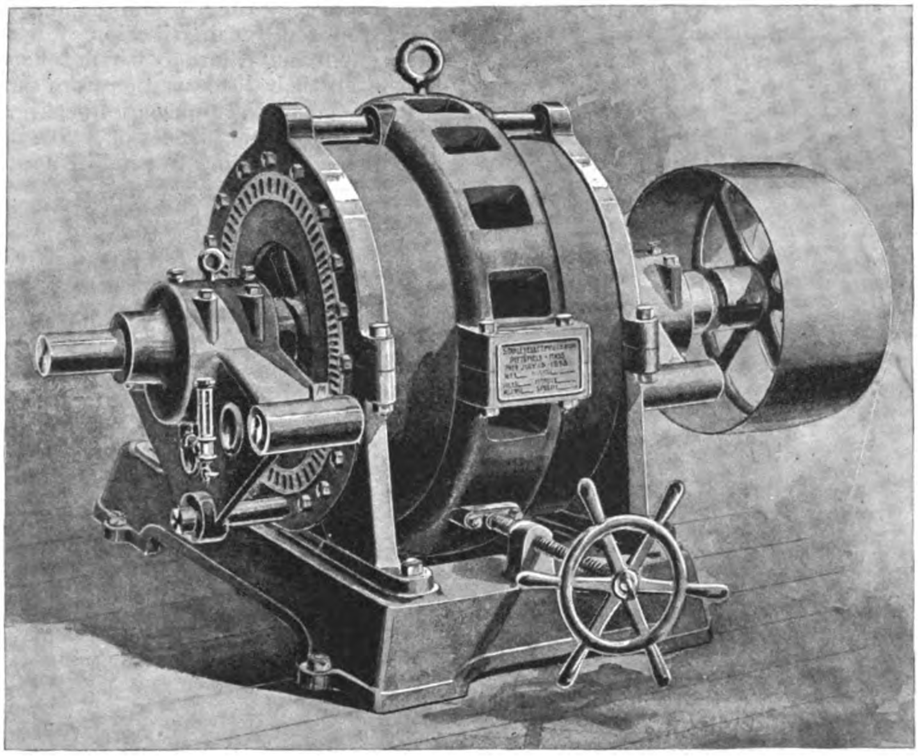


FIG. 2.—THE STANLEY ELECTRIC CO. 60 KW. TWO-PHASE ALTERNATING GENERATOR.

The field or exciting coil is circular and wound on a copper spool which rests in the centre of the machine surrounding the inductor. Constructed in this way it is easily insulated to a very high degree and, being enclosed on three sides by the heavy copper spool, danger of breaking down of the insulation due to a discharge, caused by a breaking of the field circuit when it is fully charged, is practically removed.

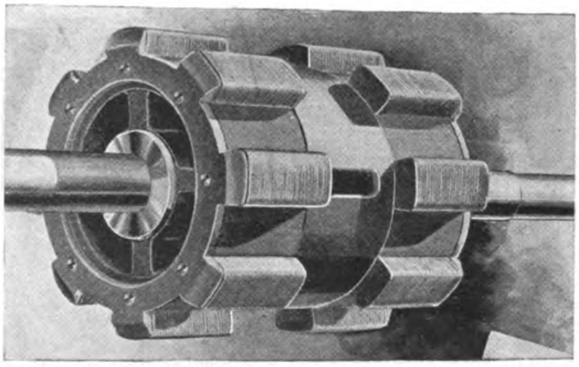


FIG. 3.—INDUCTOR FOR TWO-PHASE GENERATOR.

The efficiency of these generators is shown in the accompanying table:

	60 KW.	120 KW.	240 KW.
Efficiency at full load.......	94%	95%	96%
" " half load......	91%	93%	94%
" " quarter load...	85%	88%	90%

It is also claimed that these generators have an inherent regulation of from 6 to 9 per cent. depending upon the size of the machine and the margin of E. M. F. desired upon them.

In the generator the advantages of the toothed armature construction are secured without the irregular current wave produced by the latter. The poles, both on the armature and inductor, being stamped out of sheet iron by dies, are all exactly true and perfectly formed, and as the armature is stationary there is no need of overlapping teeth to hold the coils in place; consequently the form of the current wave produced is a sine curve. If it is desirable to run alternators coupled in multiple it can be easily accomplished with this generator owing to the fact that

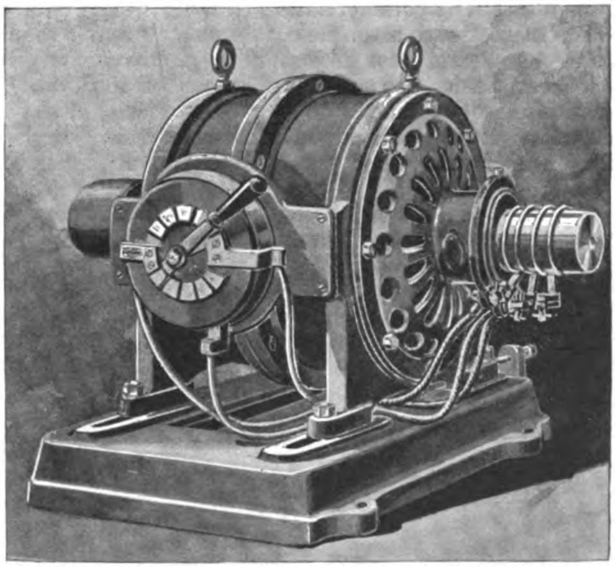


FIG. 5.—THE STANLEY ELECTRIC CO. TWO-PHASE ALTERNATING MOTOR.

the poles on any two or more machines, both on armature and inductor, being necessarily exactly alike, the form of current wave must be the same from all the machines and coincide at all times.

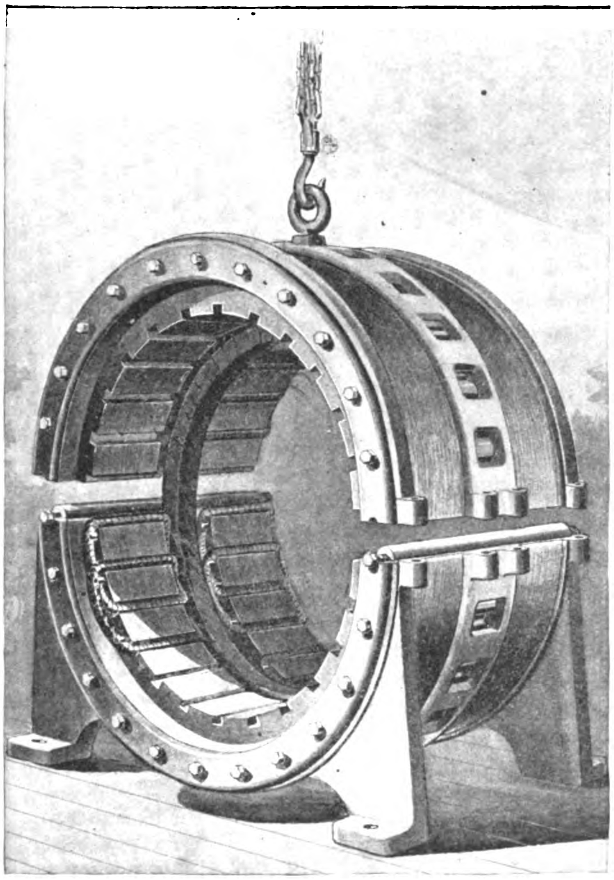
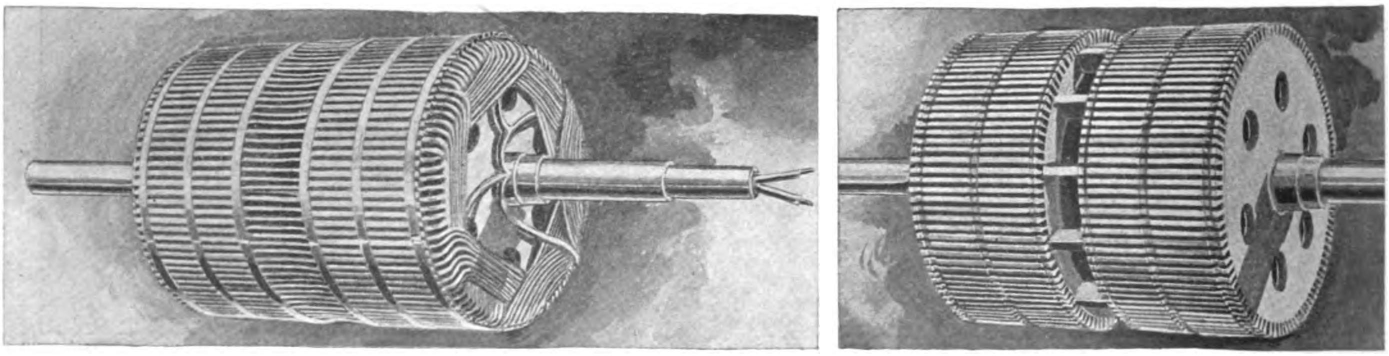


Fig. 4.—Armature of 60 kw. Two-Phase Generator.

An alternating current motor, in order to fulfill the conditions imposed by commercial service, must start from any position of rest with a torque considerably greater than its running torque; it must maintain an approximately constant speed under maximum variations of load, and its operation must not unduly disturb the potential of the system. Alternating current motors, either for single or multiphase circuits, have not been commonly introduced because of the false currents developed by such motors, the difficulty of making them with good starting torque without producing very excessive false currents, and the consequent difficulty of producing a comprehensive system for both light and power fed by the same dynamo and circuits. These false currents have made regulation difficult because they react on and abnormally demagnetize the generator and transformers. They also would make necessary the use of generators, lines and transformers so disproportionately large for the work to be done that a system handicapped by them would be uncommercial. In a commercial system for distribution of light and power widely throughout a city, motors which take current about in proportion to their load are therefore essential.



Figs. 7 and 8.—Armature of Two-Phase Alternating Motor—Wound and Unwound.

In the "S. K. C." 2-phase motor, Fig. 5, no attempt is made to combine the influences of two sets of alternating current magnets in order to produce a rotating magnetic field. It consists of two parts, a motor proper and a rotating transformer, the two parts alternately exchanging their functions. There are, electrically speaking, two fields, which are fed by currents differing 90 degrees in phase, and two armatures, though mechanically there is but one, as shown in Fig. 7. The winding is so connected that the wire which lies directly under the poles on one armature is in series with the wire lying between the poles on the other. In this position, therefore, one-half of the machine acts as a transformer and the other half as a motor.

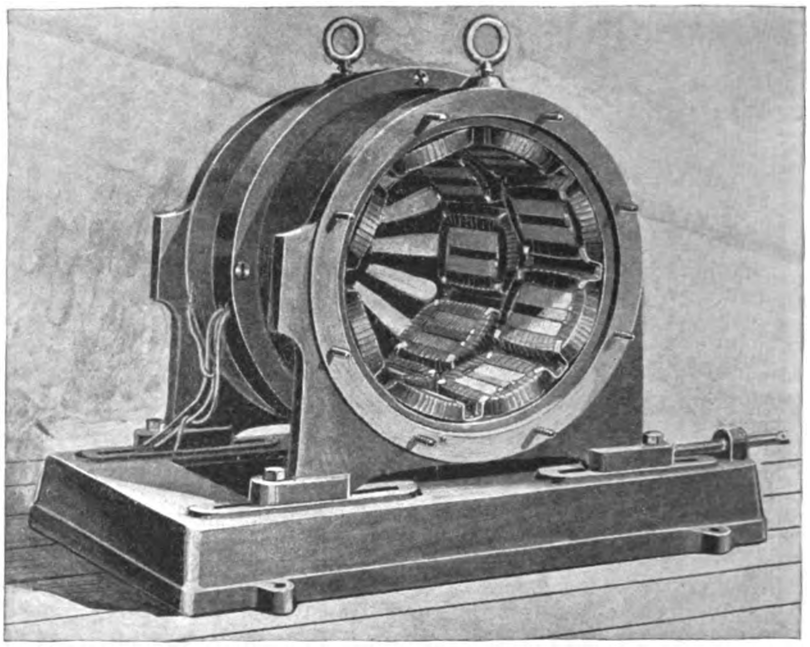


Fig. 6.—Field of Two-Phase Alternating Motor.

The armature is shown wound and unwound, in Figs. 7 and 8, from which it will be seen that the winding is not connected with the circuit and consequently the only current flowing in it is an induced current. The field construction is shown in Fig. 6. The coils are wound separately and then secured in place, and are the only part of the motor connected with the circuit. Being stationary, they are easily insulated and take an applied E. M. F. of 500 volts. A "compensating winding" is employed which consists of short circuited coils of high conductivity placed in the field poles for the purpose of neutralizing the self-induction of the armature. This construction increases the starting torque of the motors from 50 to 200 per cent. above the running torque at full load.

A unique and striking feature of this motor system is the use of the condenser, Fig. 9, whose function is to make the motor take current in proportion to its load. These condensers are connected in multiple with the fields of the motor, as shown in Fig. 10, and, when so placed, supply the lagging component of the current. Thus with this arrangement the false currents, instead of flowing back through the transformer line and generator, and disturbing the whole system, simply flow in a local circuit through the condensers. Alternating current motors and lights can thus be successfully operated from the same generator and circuit.

The efficiency of these two-phase motors is about the same as that of direct-current motors. In the larger sizes it reaches 90 per cent. and falls off gradually to 80 per cent. in the 5 H. P. and 70 per cent. in the 1 H. P., as shown by measurements with a wattmeter and not by volt-ampere readings. The variation in speed between running light and fully loaded is from 6 to 10 per cent. in the various sizes.

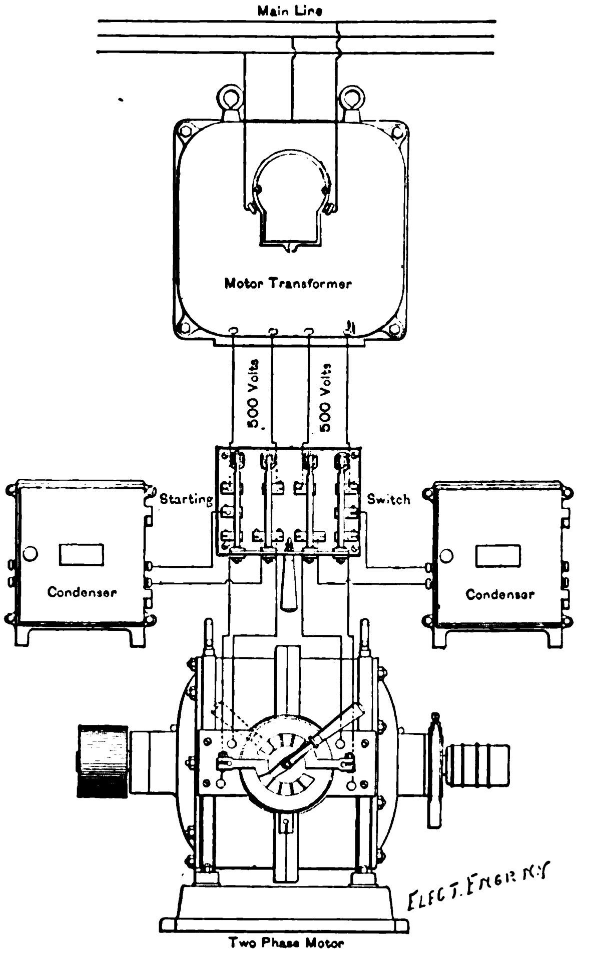


FIG. 10.—DIAGRAM OF CONNECTION FOR TWO-PHASE MOTOR.

Every day for a year and a half past these motors in various sizes have been used in Pittsfield on two-phase circuits from the central station of the Pittsfield Electric Co. This has given an opportunity to observe their performance in practical commercial operation instead of by laboratory tests. They have been running machine shops, planing mills, printing presses, elevators, woodworking machinery, carding machines, etc., on the same circuits as lights, and have consequently been subjected to trying conditions.

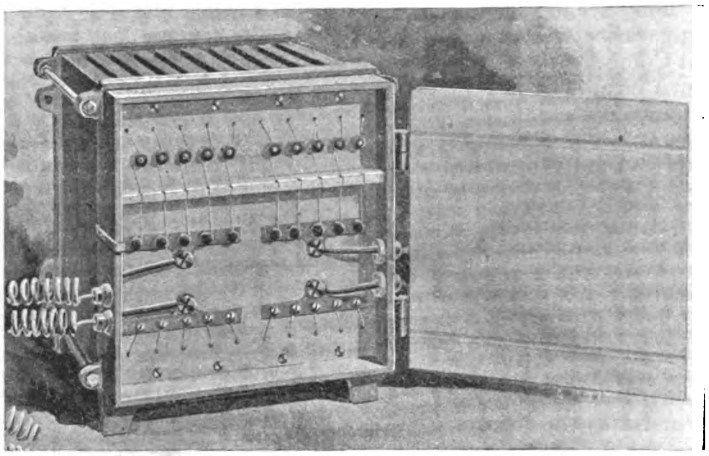


FIG. 9.—CONDENSER FOR ALTERNATING MOTOR.

Their design is neat and compact, the workmanship is of the best and no effort has been spared to bring them up to the high standard to which the other apparatus of the Stanley Company has attained.

PUPIN'S SYSTEM OF MULTIPLEX TELEGRAPHY BY ELECTRICAL RESONANCE.

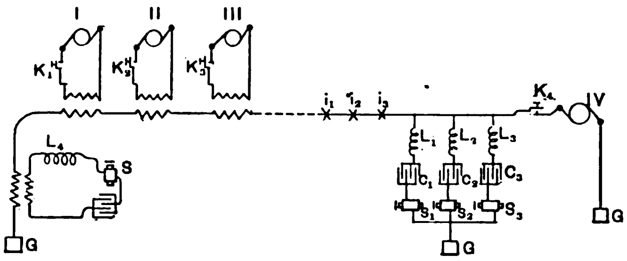
It is now fifty years since the first commercial telegraph message was sent by the Morse system, but the make and break, and dot and dash, of Morse, still hold the field against all comers. The modifications and extensions which the Morse system has undergone have been the subject of not a few volumes and have engrossed the attention of some of the greatest inventors of the past and present. Among the methods for increasing the transmitting capacity of telegraph lines that of synchronism early attracted attention, and we need only recall the work of Meyer, Farmer, Gray, La Cour, Delany, Patten and others, not to mention the type printers of Hughes, Phelps, Edison, Baudot and a host of others in this particular field, to indicate how fascinating this principle has been and the various ways in which it has been applied.

In all the systems mentioned above, however, the underlying principle has been to cause a reed, wheel or other mechanical device at the receiving end of a line to move in synchronism with another apparatus sending electric impulses from the transmitting end. The synchronous movements at each end have invariably been obtained through the intervention of *moving* devices which almost without exception require a high degree of adjustment and usually embodied some "correcting" device to maintain the moving parts at the two ends in synchronism. Recent investigations in electrical resonance, however, would appear to have made all moving synchronizing mechanism unnecessary and its application to multiplex telegraphy is one of the results of the researches of Dr. M. I. Pupin, whose work in this and in other branches has been recently noticed in our columns.

In order to understand the working of Dr. Pupin's new system, it may be well to recall that among the multiple systems proposed, such as the Gray, a number of impulses are simultaneously sent over the line by a set of reeds vibrating at different periodicities, which impulses are individually picked out at the distant end by reeds tuned to respond respectively to the transmitting reeds. In the Pupin system, the impulses, instead of being picked out by corresponding vibrators are picked out by a combination of an inductance coil and condenser, "tuned" in the well-known way to that particular vibration, that is, having the same time constant as the initial vibration. Instead, also, of employing reeds, alternating currents produced by alternators of different periodicities are employed.

The accompanying diagram shows the method and apparatus employed by Dr. Pupin in a test made last week at Columbia College in the presence of a number of gentlemen interested in telegraphy. At the transmitting station, shown at the left, the alternators I, II, and III send impulses into the line through transformers, a key in the circuit of each serving to send the impulses in the form of dots and dashes, as usual. The alternators I, II and III, respectively, send alternating currents of 70, 130 and 250 periods per second into the line.

At the distant end, the circuit first passed through three incandescent lamps of 350 ohms each, in series, indicated at i_1 i_2 i_3, and then three taps were taken off and the current in each passed through an inductance coil L_1, and a condenser C_1, and a sounder S_1, the others being lettered to correspond; and thence to ground. The alternator IV illustrates the transmission in the opposite direction.



Pupin's System of Multiplex Telegraphy.

Now it will be understood that if the inductance coil L_1 and the condenser C_1 are adjusted or tuned to respond to the periodicity of the alternator I it will allow the impulses from that alternator alone to pass through and operate sounder S_1, and will remain opaque to all other impulses coming over the line. The same is the case with the other combinations L_2, C_2, S_2, and L_3, C_3, S_3.

During the test Dr. Pupin showed how, by varying the inductance or the capacity, the tap lines would be thrown out of tune, but when once adjusted remained so indefinitely. Three circuits were shown in operation, and were worked simultaneously, singly or in pairs, without mutual interference.

In discussing the probable limits to which this system could be worked Dr. Pupin expressed the opinion that, beginning with 25 periods per second, the separate impulses sent over the line could be increased in steps of 25 up to 1,000 periods per second, so that 40 messages could be transmitted simultaneously, all in one direction or divided in any desired manner from either end.

ELECTRIC LIGHTING OF SHIPS ON THE MANCHESTER CANAL.

Arrangements have been made to light vessels passing through the Manchester canal. At the Eastham Locks and the Manchester Docks end, the firm undertaking the work has complete portable electric plants, comprising small engines and dynamos combined, and a search light projector of the Admiralty pattern, with a staff of men for working the apparatus, which is of similar type to that which it has used with very good results for lighting vessels through the Suez canal. The search light is of 40,000 to 50,000 candle-power, enabling the vessel clearly to distinguish the banks, buoys, locks, etc., three quarters of a mile ahead, and it also provides powerful electric mast lamps of 8,000 candle-power to light up vessels and surroundings when coaling at night, or tying up, entering locks, docks or moorings.

ESTIMATE OF THE DISTANCE TO WHICH NIAGARA WATER POWER CAN BE ECONOMICALLY TRANSMITTED BY ELECTRICITY.—A REPLY TO MESSRS. HOUSTON AND KENNELLY.

BY CHAS. E. EMERY.

In the writer's discussion[1] of the valuable paper of Messrs. Houston and Kennelly[2] on the above subject, he tried to point out four distinct features or points of inquiry or criticism, two only of which are discussed by the gentlemen in their recent analysis of his remarks.[3] One reason why a discussion is more interesting than an original paper is the opportunity for cross fire and, if one of the parties can be shown to have contradicted himself, the interest intensifies, at least temporarily. We find ourselves in the latter position in relation to the first but least important of our four points, to wit, the saving due to the use of larger engines than those considered in our table, with which comparison is made. We stated during the discussion of that paper, as we then believed, that there would be little or no difference between the complete costs per H. P., if larger engines were used than those then considered. In our discussion of the subject now under consideration we simply stated there *would* be a difference, thereby making ourselves liable to legitimate criticism by neglecting to state definitely that we had reasons to modify our original opinion. It therefore becomes necessary to state such reasons now, confining ourselves to engines employed to operate electric generators.

When the investigations were made on which the paper was based the use of large combined engines and dynamos or "engine dynamos" had not in this country become general, though exciting great interest. The apparatus previously constructed had been high priced and attendance expensive. Since that time engines of familiar rather than special types have been directly connected to large generators and provision made to mass many such units in one place, whereby the attendance can be brought to a minimum. Moreover, the lower price per H. P. of large engines of ordinary type has become an important factor. The conditions, therefore, have been changed materially. The saving in cost of attention may not be realized in all cases, but a comparative saving in construction should be general. Just what the effect would be on the comparisons in our tables cannot be stated without a careful investigation, which will not be warranted until conditions are more settled. Therefore the subject was simply mentioned in our discussion and no definite comparison made from which the value of such difference could be ascertained.

Our second point was, that the percentages added for various reasons to net cost by the writers of the paper were materially less than in our paper on steam power. This appears to be conceded, and in this connection it should be remembered that our discussion finally allowed that of Messrs. Houston and Kennelly 5 per cent. advantage, for no other reason apparently than not to take extreme views.

The fourth point we suggested, to wit, the necessity of using, on the average, smaller motors at the end of the line than calculated for by Messrs. Houston and Kennelly, which, with necessary spare machinery, etc., would have the effect to greatly increase the estimated cost, appears also to have been conceded.

The third suggestion that probably the efficiency of the generator and transformers at average load had been overestimated, is met with the statement that with 90 per cent. efficiency about 11 watts of energy must be dissipated per square inch of the probable armature surface of a Niagara generator which they say "will probably result in a temperature for the armature approaching red heat, the usual safe allowance being one watt per square inch of armature surface." The exciting force stated is believed to be much lower than will be obtained in a commercial generator, but even if it be accepted, similar calculations on the same basis will show that if the efficiency of the generator were 94 per cent., it will still be necessary to dissipate over 7 watts per square inch, and, if 96 per cent., over 3 watts per square inch,—both beyond the limits which have been found possible for continuous operation in ordinary practice. The general conclusion, then, from the arguments of our learned friends is that the generators will overheat and therefore cannot be run to capacity. This implied reflection on those who are designing the generators and will be responsible for their performance was, of course, not intended. On the contrary, no one is as yet possessed of facts which make criticism practicable, and discussions of this kind must be confined to general considerations rather than special devices.

Evidently the mere statement that a low efficiency will involve an enormous dissipation of energy as heat does not of itself prove that the efficiency will be high. The superficial dimensions of a generator necessarily increase much slower proportionally than the capacity, as sizes are increased, and conversely the dimensions must be increased out of proportion if present established rules as to the dissipation of heat are to be followed. It can therefore as well be assumed that successful operation will be obtained by unusual means to dissipate heat as by the use of means to obtain high efficiency, which will necessarily increase the weight and cost in relation to capacity. It is, moreover, pretty well understood that some special means are to be used to cool the armature. To be sure, there are rumors of 98 per cent. efficiency, but if any such result has been guaranteed it of course refers to the "electrical efficiency." Any comparative falling off in "commercial efficiency" will be of minor importance at the Niagara end of the line where power is so cheap if the use of a little more power will dissipate the heat due to both the copper and iron losses in the armature. Some compromise between the two methods will undoubtedly be employed. It is, however, impossible for any one to properly discuss such points until the details of the design and exact dimensions are available. The data upon which we based our estimate of efficiency may have been inapplicable. We trust it was, but all our experience with new work teaches us that there will be unexpected drawbacks more than sufficient to balance any possible discrepancy.

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[1] Elec. Engr., May 23. [2] Elec. Engr., May 2. [3] Elec. Engr., May 30.

The chief object of our previous remarks was to call attention to the very great differences in result which would be produced by some comparatively small changes in efficiency and highly probable changes in first cost, with a view of providing for contingencies that inevitably arise in connection with new work. The actual contingencies may be different without affecting the result. The suggestions are in line with those of others with whom we have discussed the subject. Electrical progress has been checked by, and large money losses have resulted in the past, from sanguine estimates and statements based on possible rather than probable results, and we are gratified to find our general views expressed in a different but very forcible way in the discussion of Messrs. Crocker & Rittenhouse.[4]

AN ESTIMATE OF THE DISTANCE TO WHICH NIAGARA WATER POWER CAN BE ECONOMICALLY TRANSMITTED BY ELECTRICITY.

BY EDWIN J. HOUSTON, PH.D., AND A. E. KENNELLY, F.R.A.S.

WE have read with interest Professor Anthony's able article "On the Conditions of Economy in Long Distance Transmission of Power by Electricity."

We note that Professor Anthony in his paper has discussed a problem different from that we adopted, namely, the cost of transmitting Niagara power at a maximum pressure of 50,000 volts at the sending end of the line, while we adopted the same maximum pressure at the receiving end, as we expressly stated. Of course it is true, as stated by Professor Anthony, that in the case of the long distance line from Niagara to Albany, the pressure at Niagara would be in the neighborhood of 90,000 volts at the peak of the wave between wires, or about 64,000 volts between wires, effective. In the cases of the cities nearer Niagara, this difference in pressure at the ends of the line would be less marked, and in the Buffalo transmission it would be scarcely appreciable.

Both the pressures assumed by Professor Anthony, and those taken by ourselves, are higher than any engineer would be justified in guaranteeing without previous experience, for although 30,000 volts effective is a pressure which may be reasonably assumed as practicable, since it was actually employed with success in part of the Lauffen-Frankfort experiments, yet it has never been put into practical trial in this country. Our article, as its name indicates, was an estimate based upon conditions clearly expressed. We chose to fix a limiting pressure for the receiving end, rather than for the sending end, for the reason that we believe there is a greater danger from the manipulation of high pressures at the receiving than at the transmitting end.

We notice a slip or misstatement, possibly a misprint, in Professor Anthony's fourth equation, but his concluding reasoning and results are in substantial agreement with those we obtain, and it is interesting to point out from Professor Anthony's conclusion, that the cost of delivering Niagara power in Albany with an average load of 0.6 maximum and 24,500 volts effective between wires at Albany is $50.51, whereas at the pressure of 35,350 volts we assumed, under otherwise similar conditions, this estimated cost is $36.90, so that even at the lower pressure which Professor Anthony adopted, Niagara power can still compete with steam in Albany for 24-hour service. There is, therefore, no discrepancy between our results and those of Professor Anthony, and we are pleased to see our conclusions endorsed by so able an electrical engineer.

LABORATORY OF HOUSTON AND KENNELLY,
PHILADELPHIA, May 31, 1894.

MR. W. D. SARGENT made some admirable arguments recently in an interview in the *Brooklyn Eagle*, showing the various points in which lies the value of telephone service. He said that the vast majority of subscribers in Brooklyn were well disposed toward the company and satisfied with the service.

EXCITATION OF GENERATORS.

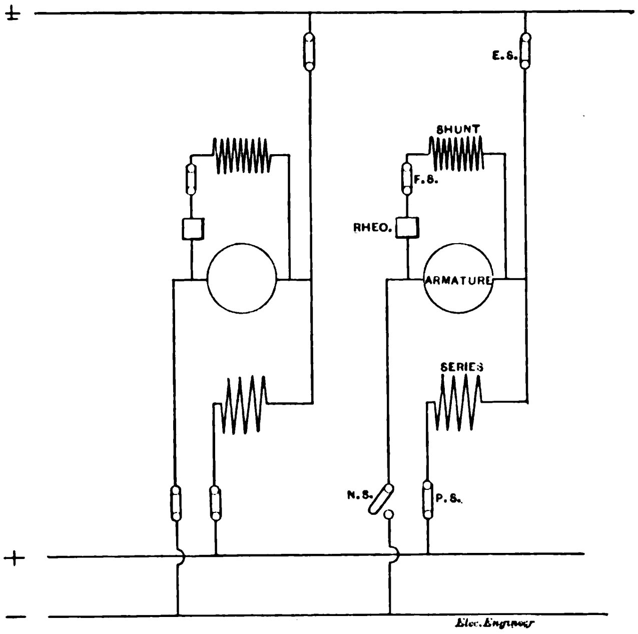
BY W. B. POTTER.

IN Mr. C. S. Van Nuis' article (THE ELECTRICAL ENGINEER, May 2), he outlines an arrangement of combined bus and self-excitation whereby the building up of the field of additional generators after the first, is much hastened as compared to self-excitation only. A means to this purpose is certainly an advantage, but while his scheme ingeniously accomplishes the result, so far as time is concerned, there are certain objections, some of which are mentioned by Mr. A. B. Herrick (THE ELECTRICAL ENGINEER, May 23).

This result can be accomplished in a simple manner by fitting the generator panel with independent single pole positive and negative switches, and such an arrangement gives not only the advantage of separate excitation to a sufficient degree to render the time required to build up the field a matter of a few moments, but renders it possible to easily connect additional over-compounded generators in parallel with others operating at full load.

By reference to the accompanying diagram, it will be seen that by closing the positive switch P. S. (the equalizer switch, E. S. being closed) the series coil of the generator to be started is connected in parallel with the series coils of generators in operation, thus separately exciting the field of the generator to be started.

The field switch, F. S. being closed, the voltage is then adjusted by the field resistance to correspond with that of the bus, and the more easily so, as by this method there is secured a variation of voltage corresponding to that due to changes of load on the over-compounded generators in operation. This method also ensures the polarity being at all times the same as the other generators. On closing the negative switch N. S. and reducing the resistance in the shunt field, the generator takes up its load smoothly and without the violent fluctuation usually caused by connecting the series coils after the full potential has been developed by the shunt field only.



EXCITATION OF GENERATORS.

It is true that until the additional generator takes up its load, there is a slight alteration in the compounding of the generators in operation, but this variation is not sufficient to be any objection. The necessity of opening the shunt field circuit at high potential is obviated as the field switch may remain closed until the generator is shut down, and the advantage of separate excitation, so far as starting is concerned and self-excitation for operation, are thus secured without complication of switches.

The General Electric Co. have equipped a number of railway power stations with this arrangement, and the results have proved so satisfactory that it has been adopted as the standard for power stations having large over-compound units.

THE TURPIN ELECTRIC WAR CHARIOT.

All political and journalistic France is torn up by reports that the French War Department refused to buy from M. Turpin, the inventor of melinite, a new electric chariot or mitrailleuse firing automatically 25,000 bullets a minute, and that M. Turpin thereupon sold his invention to Germany.

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[4] ELEC. ENG., May 30.

AN OPTICAL PHASE INDICATOR AND SYNCHRONIZER.[1]

BY GEORGE S. MOLER AND FREDERICK BEDELL.

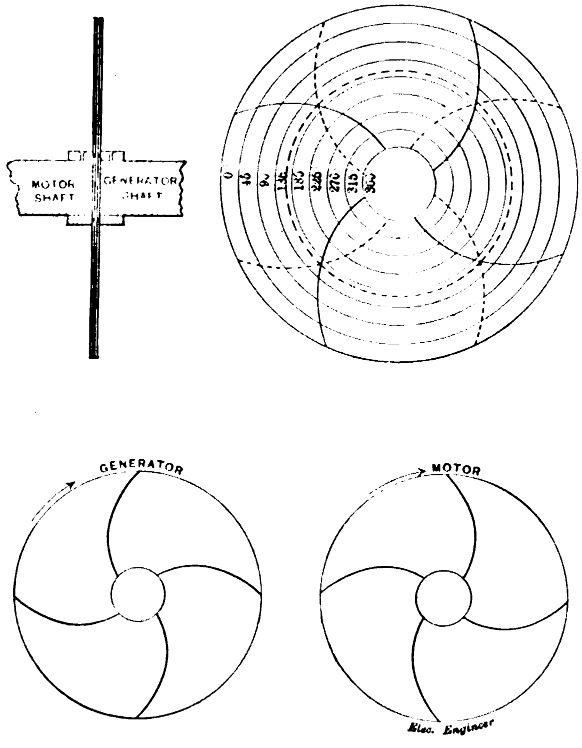
THE following instrument has been devised by the writers to give definite information in regard to the relative speeds and phase positions of the motor and generator in laboratory investigation. It shows

(1) When the machines are synchronous;

(2) Which machine is running the faster when they are not synchronous;

(3) The angle by which the motor lags behind the generator.

We will first describe the simplest form of the phase indicator. The motor and generator are placed together with shafts in line and abutting, but not quite touching. The two machines must have the same number of poles, so that a revolution of the armature of each represents the same number of alternations. The abutting ends of the shafts carry two discs, one connected rigidly with the motor armature, the other similarly connected with the armature of the generator, as shown in Fig. 1. In these discs are curved slits, one slit for each pair of poles of the machines. These slits are shown in Fig. 2 for an eight pole machine. The two discs are in every way similar, the one being the reverse of the other. The two discs are practically superimposed, and together form one disc with four holes, where the slits of one disc cross over the slits of the other. Evidently the distances of these four holes from the centre depend upon the relative positions of the two armatures; they move in and out as the armatures shift their relative positions. From the symmetrical arrangement of the slits, if one armature is stationary and the other is moved past two pole pieces or through 90 degrees of arc (corresponding to a complete period of alternation, or 360 degrees of phase) the intersection of the slits will be the same distance from the centre as before. The curvature of the slits is such that the distance to or from the centre that the intersections of the two sets of slits move is proportional to the change in relative position of the two armatures.



OPTICAL PHASE INDICATOR AND SYNCHRONIZER.

When the two armatures are running at the same speed in the same direction and there is a source of light on one side of the discs, the intersection of the slits, as seen from the other side, appears as a continuous ring of light. A slight difference of speed causes this ring of light to move outward or inward, according to which disc is revolving the faster. The more rapidly the ring moves in or out, the greater the difference in speed of the two discs. If the ring is moving out, a new ring starts at the centre when one ring reaches the edges, and these rings keep following one another outward. If the difference in speed is the other way, the successive rings move inward.

In Fig. 3 the heavy dotted line represents the ring of light for a particular position of the two discs. The position of the ring of light indicates the relative position of the two armatures. The discs may be secured to the shafts, so that when the armatures are in the same positions with reference to the pole pieces (*i. e.*, the machines are in the same phase), the ring of light will be at the inner or outer ends of the slits. The concentric rings in Fig. 3 represent the phase differences corresponding to positions of the ring of light in this case.

For convenience in operation, the arrangement of the apparatus, which has thus far proved satisfactory, has been as follows: On one side of the pair of discs is placed an incandescent lamp enclosed in a box. One side of the box is close to the discs and has a slit in it about half an inch wide, extending from the shaft to the circumference of the disc. This slit is covered with a piece of oiled paper, so as to give a diffused light upon the discs. A complete ring of light is no longer seen from the other side, but only a small portion, corresponding to the width of the half inch slit. A stationary scale is fixed so as to extend from the shaft to the edge of the discs on the opposite side from the lamps, so that the distance of the changing line of light from the centre may be read so as to give the phase difference of the two machines by direct reading. To enable one to see the scale and line of light most conveniently, a mirror is arranged at 45 degrees with the discs, so that the line of sight is at right angles to the shaft.

The discs may be arranged in the manner just described upon the abutting ends of the motor and generator shafts only in case the two machines have the same number of poles. Where such is not the case, one or both of the discs can be driven by gears, which will give the proper relative speeds of the two discs.

In operation, the instrument has proved quite satisfactory, giving exact and definite information concerning the changes in the armature lag of the motor. The fluctuations in this lag are usually quite marked, and the conditions which cause them can be readily investigated by this apparatus. For instance, this fluctuation is small with proper field excitation; as the field current of the motor is diminished, this fluctuation increases, the line of light moving rapidly back and forth through a greater and greater distance, which finally becomes so great as the excitation is weakened that it goes a distance beyond which it cannot recover; *i. e.*, the motor gets out of step and stops. It would be possible to make a more detailed investigation of these fluctuations by means of a revolving mirror, and they may be photographed and made of permanent record by means of a moving plate.

The apparatus can be applied to other lines of work involving an investigation of phase differences and synchronism, and may be modified to meet the requirements of the problem in hand; but it is peculiarly suited for use in synchronous motor work, for which it was designed. The scope of the present paper admits only of a general description of the apparatus here given.

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[1] Abstract of a paper read at the Philadelphia meeting of the American Institute of Electrical Engineers, May 17, 1894.

POLYMORPHIC ELECTRIC GENERATORS AND TRANSFORMERS OF ENERGY AND THEIR INDUSTRIAL APPLICATIONS.

This is the title of an interesting paper read by M. Hospitalier on May 18, before the French Physical Society and the Société Internationale des Electriciens.

Electrical energy to-day presents itself in the form of continuous, alternating, two-phased and three-phase currents, but these forms may easily be transformed from one to the other, and these transformations are already being utilized in practice. M. Hospitalier showed upon the screen several views of machines already built, among them the Schuckert for transforming continuous into two-phase currents; the 300 K. W. Westinghouse machines at Rochester, giving two-phase currents at one side and continuous currents at the other; and the Tesla machine of 750 kilowatts. Mr. Hospitalier finally presented a synoptical table containing all the possible transformations and apparatus for obtaining them. We give below the explanations given in connection therewith:

I. *Continuous currents can be transformed into:*

A. Alternating currents, by means of a Solignac "undulator" and a transformer as employed for the welding of rails.

B. Two-phase currents, by means of the Schuckert apparatus.

C. Three-phase currents by means of the apparatus of Dolivo-Dobrowolsky and Hutin and Leblanc.

II. *Alternating currents can be tranformed into:*

A. Continuous currents by means of the Gaulard or Lane-Fox apparatus and the arrangement employed at Cassel (alternating motors driving continuous current generators).

B. Two-phase currents, by utilizing capacity, self-induction and mutual induction.

C. Three-phase currents, with non-synchronous closed circuited armature and field magnets wound as secondaries (Potier).

III. *Two-Phase currents can be transformed into:*

A. Continuous currents, by means of two-phase motors operating continuous current generators (Budapest).

B. Three-phase currents, by means of the Scott transformer.

C. Single alternating currents, without special apparatus, by taking the current from the individual branches.

IV. *Three-phase currents can be transformed into:*

A. Two-phase currents by means of the Scott transformer.

B. Single alternating currents without special apparatus.

C. Continuous current, by Lahmeyer motor transformer, or Hutin and Leblanc apparatus.

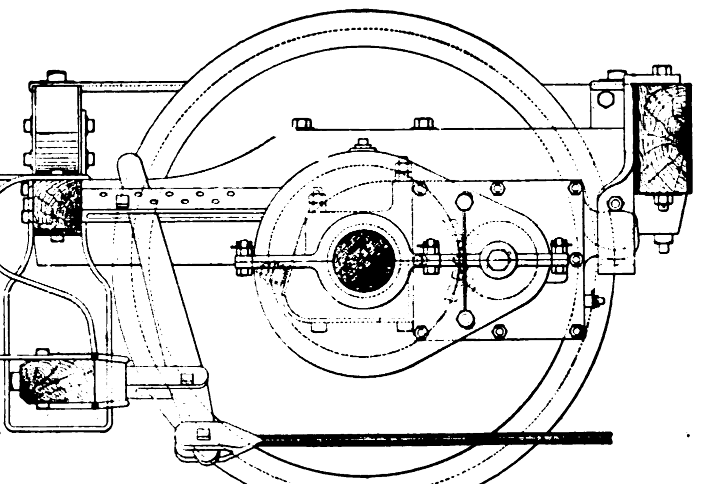
The paper was illustrated by numerous interesting experiments.

THE BIDDLE SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY TRAINS.

For several years efforts have been made to introduce electric lights on railway cars, and many different devices have been brought forward only to be discarded as impracticable or unduly expensive. Simple storage batteries were first tried but failed to render complete satisfaction. The most extensively developed method of electric car lighting heretofore introduced provided a steam motor in the baggage car, fed by steam from the locomotive, by which a dynamo was driven to generate an electric current carried through the train by wires extending from car to car. This plan required the constant attendance of an electrician and has been found expensive.

One of the latest devices is that recently perfected and introduced by the American Railway Electric Light Company of which Ex-Governor Alonzo B. Cornell is president. It provides a plain gear wheel attached to the car axle connected by ordinary cogs with the shaft of the dynamo, which is securely placed on the car truck, as shown in the accompanying illustration, and, by the use of a storage battery, the light is maintained uniform. Each car is thus independently provided with its generating and illuminating apparatus, so that cars may be detached from through trains when desirable and sent over connecting roads. All of the mechanism is placed beneath the floor of the car, completely encased to avoid dust and dirt, so that no space is occupied within the car.

The dynamo is compound wound with the series winding in reverse to the shunt, which acts as a governor when the higher speeds are reached, and keeps the electromotive force nearly constant. It is stated that if the dynamo is wound to give 30 volts and 35 amperes at 25 miles per hour, it will not vary 5 per cent. at 60 miles per hour. The system is automatic throughout. The current is regulated by an automatic cut-out and pole changer combined, the pole changer device taking care of the direction in which the car is moving, and the cut-out acting when the machine stops, and throwing in the storage batteries.


THE GENERATOR ON THE TRUCK.—BIDDLE SYSTEM OF CAR LIGHTING.

The illustration shows the generator on the inner axle of a six-wheel truck. One end is journaled on the axle, and the other supported on a stirrup from the truck frame, to avoid the danger of lateral strains. The gears are tightly enclosed and run in oil, and the whole weighs only 250 pounds. The generators are built by the C. & P. Manufacturing Co., of 647 Kent avenue, Brooklyn, and are of two sizes. For drawing room and sleeping cars, etc., a 32 light, 16 c. p. machine is used, giving 30 amperes at 65 volts, while for ordinary service a 20 light, 10 c. p. generator giving 35 amperes at 24 volts is sufficient.

The system is the invention of Mr. William Biddle, of Brooklyn. The company's offices are in the Vanderbilt Building, corner of Nassau and Beekman streets, this city.

LONG DISTANCE TELEPHONY IN KANSAS CITY.

The opening of the long distance telephone line between Kansas City, Leavenworth and Atchison was celebrated on May 22, by a reception at the Commercial Club, Kansas City, accompanied by speeches and a concert. Mr. T. D. Lockwood was the chief orator, and made a highly successful address. The programme was carried through by Mr. W. W. Smith, superintendent of the Missouri & Kansas Telephone Co.

ELECTRICITY VS. COAL FOR HEATING PURPOSES.

BY M. IRVING MOTTE.

THE subject of heating of electric cars is one which has long interested railroad men, destined, as it is, to play so important a part in electric railroading. A car which is propelled by an electric motor should be warmed by an electric heater. Any other method is incongruous and in many cases ineffectual.

In the past the great objection of railroad men to electric car heaters has been their short life and their operating cost. These two objections have been overcome. The cost of electrical car heating is not prohibitive, and a properly designed car heater should have an almost indefinite life, at any rate as long as, or longer than, the coal stove.

To estimate the cost of the average electric horse power hour is, under any circumstances, not an easy matter, as conditions are so different in every central station. But it seems fair to assume, using figures from Dr. Emery's tables, as quoted by Houston and Kennelly in the article in THE ELECTRICAL ENGINEER of May 2, that an electrical horse power hour costs about $\frac{6}{10}$ of a cent. (See Dr. Emery's paper read before the American Institute of Electrical Engineers.)

It has been demonstrated that a 20-foot car can be warmed to a comfortable temperature, say 50 F., in all weathers, by a consumption of 4 H. P. At $\frac{6}{10}$ of a cent per hour this makes $2\frac{4}{10}$ cents as the cost per hour of heating a 20-ft. car. The average time of cars on the road is 12 hours a day, which gives us $28\frac{8}{10}$ cents cost per car per day. The usual fare trip is of 35 minutes' duration, which gives 20 passenger changes per day.

To the writer's knowledge there are at present only two feasible ways of heating electric cars, coal and electricity. Therefore the question must lie between these two agents.

Concerning coal, the strongest argument against it is the fare earning space the stove takes up, which is equal to the space of two passengers, and in a crowded car would mean the loss of two fares or 10 cents per trip. Assuming that a car is crowded one trip in four, and that 10 cents is 50 % too high, this means a loss of 25 cents a day to the road. The above stated loss of 25 cents, plus 15 cents which is the generally allowed cost of running a coal car stove will readily be seen to be much greater than the cost of the electrical heater.

So much for the monetary side of the question. Now how do the coal stoves heat a car? In a very irregular fashion. The middle of such cars is usually warm enough, but the ends are nearly as cold as the outside air. An explanation of this lies in the fact that to make it at all possible for the passengers to sit beside the stove, its radiation must be almost wholly screened off and in this way the rest of the car is likewise screened off, and left in comparative cold.

The coal stove cannot be so readily or instantaneously regulated for changes in temperature as the electric heater and for that reason is often a source of great annoyance to the passengers, when toward spring just a little heat is required to take the chill off a car, and the amount of attention which a coal stove requires, is out of all proportion greater.

There is an increasing demand on the part of the traveling public all over the country for properly heated electric cars. It is a demand which can only be met by electric heaters.

PERSONAL.

MR. JOSEPH SACHS has opened an office at Room 578, Mutual Life Building, 32 Nassau street, as a "devising" and consulting electrical engineer. He will make a specialty of assisting inventors to work out their ideas in tangible and practical shape. He is one of the few electrical engineers in this country who has made a study of electrical navigation, and his recent excellent lecture before the New York Electrical Society on the electrical propulsion of canal boats was a valuable contribution to the data of the art.

MR. C. J. H. WOODBURY, the well-known engineer and technical litterateur, has resigned his position as vice-president of the Boston Manufacturers' Mutual Fire Insurance Co., and will join the staff of the American Bell Telephone Co. on Sept. 1. He will, however, enjoy July and August as a vacation, which has been well earned. Mr. Woodbury has been engaged in engineering and insurance work for 25 years continuously, except for a short trip to Europe in 1889. His insurance work has dealt largely with the technical and engineering side of the insurance problems. An admirable account of his career was given by Mr. J. C. Baylis in *Cassier's Magazine* for Sept. 1892.

THE BIMETALLIC ELECTRIC TRANSMISSION CO. has been organized to introduce bimetallic wire for telegraphic and telephonic purposes. The office of the company is at 80 Broadway, and the officers are W. H. Eckert, president, Willard M. Miner, vice-president and W. S. Eckert, secretary and treasurer.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

New England Editor and Manager, A. C. SHAW, Room 70—620 Atlantic Avenue, Boston, Mass.

Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HANKS.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - - "	2.50
Great Britain and other Foreign Countries within the Postal Union "	5.00
Single Copies, - - - - - - - - - - - - - -	.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

VOL. XVII. NEW YORK, JUNE 13, 1894. No. 319.

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GERMAN CENTRAL STATION STATISTICS.

THE value of reliable statistics properly classified and digested is too well known to require special pointing out, but it is sometimes forgotten that they are especially valuable when relating to new industries such as electric lighting and power distribution. Various attempts have been made by the National Electric Light Association to supply this very necessary data, but the work thus far accomplished must be regarded as but a tithe of that necessary to enable the central station manager to compare the operation of his own station with that of others. Thus, at the last Convention held in Washington the statistics submitted were limited practically to the consumption of coal per horse power hour in central stations. This was good enough in itself but manifestly it covered but a part of the working of a central station. It may be that the lack of information necessary to draw up comparative statistics is due to the loose or inadequate methods of bookkeeping employed in the majority of central stations in this country, and perhaps the National Electric Light Association could do no better than to start anew in its statistical work by indicating a method of keeping accounts which would enable central stations to fill out the information blanks by a rapid inspection of their books. Such blanks for keeping station accounts are available, among others those prepared by Mr. Horatio A. Foster, and the adoption of a uniform set something after the same plan by all stations would make the matter of obtaining reliable station statistics a comparatively easy task.

In marked contrast to the American lack of data in this respect are the statistics from Germany. We have before us two statistical compilations, one embodying the work of the German Elektrotechnische Verein and the other that of the "Free Association of Electric Light Station Representatives." Naturally both sets of statistics cover much of the same ground, but they differ somewhat in their modes of tabulation and each has a distinct value of its own. That of the Elektrotechnische Verein gives the tabulated results of central stations in 24 cities, including four having over 250,000 inhabitants, seven between 75,000 and 250,000, seven between 10,000 and 75,000, and six under 10,000. These stations employ probably all the various ordinary methods of generation and distribution and allow some quite definite conclusions to be reached on hitherto doubtful points.

Comparing the cities for current capacity installed per 1,000 inhabitants we find it to vary considerably and, as would hardly be expected on first consideration, to average higher in the smaller cities than in the larger ones. It amounts in Berlin to 5.81 kilowatts per 1,000 inhabitants. A glance at the cities of the third group shows that the consumption of current is largely increased by the adoption of a sliding scale. The proportional distribution of lighting in hotels, dwellings, theatres, etc., varies of course with the character of each city. Thus, whereas in Berlin the percentage of current furnished to dwellings and hotels is only 19.9 per cent. of the total consumption, it amounts to 38.7 per cent. in Hamburg. A greater constancy in this respect is shown in store illumination, at least in the larger cities, where 30 per cent. of the total is about the average of current consumed in such places. This is in marked contrast to the figures in the United States in which hotels and private dwellings represent but a small fraction of the current consumed, by far the largest percentage being devoted to store and office illumination. This fact is due, in part, probably to the larger number of isolated plants in the United States. Factory lighting represents but a small fraction of the whole, which is easily accounted for. Unfortunately the data on street illumination is incomplete, so that no comparison can be made in this respect.

The amount of electric power consumed in German cities is of special interest. From the tables it would seem that the cities of medium size employ but very small quantities, whereas the larger cities take proportionately more current for this purpose. Thus Berlin and Vienna employ, respectively, 8.6 and 6.8 per cent. of the total current generated, for power purposes. Glancing at the actual electrical energy consumed we note that Berlin stands at the head with 6,700,000 kilowatt hours per annum, followed by Vienna with 1,300,000; then comes Hamburg with 500,000, and s'Gravenhagen, Dusseldorf and Elberfeld with 300,000 each.

The charges for current in Germany show a most varied practice. A fixed charge per lamp installed is exacted in Berlin and Innsbruck. In Vienna-Mariahilf this charge is waived beyond 100 lamp hours per lamp. In Heilbronn a charge is only made for the first 10 incandescent lamps or the first 2 arc lamps; in the first case $1.87, and in the later $10. A sliding scale is in vogue in several cities. The cheapest rates are to be found in Triberg where the lamps are divided into three groups. The first group includes such lamps as are burnt in winter and summer at definite times; the second, lamps which are burnt only in winter or only in summer; and third, lamps which are used temporarily only. The prices are also graded according to whether the lamps are used in hôtels, dwellings, stores or factories. There result from this no fewer than 12 different rates of charge varying from $9 to $90 per kilowatt per annum.

The average price of current in stations selling by meter is a little over 18 cents per kilowatt hour, the highest being 22½ cents, but the discounts vary considerably in different localities. The rates for electric power are arranged on a variety of plans. In Düsseldorf and Hamburg each case is treated individually and a special price fixed. In other cities there are flat rates without discount, as in Barmen, Berlin, Stockholm and other cities. The highest price is that in vogue at Gummersbach, namely, 13 cents per kilowatt hour. In Berlin, however, the low price of 5 cents obtains, while at Triberg power is actually sold at 2½ cents per kilowatt hour. It goes without saying that current for power purposes can be furnished at a lower cost than for lighting, but one is hardly prepared for such generally low prices, as these statistics show. For those who argue that the electric light and electric power are luxuries, the German statistics will prove a revelation. They show, in fact, that in the larger cities electric light is but slightly dearer than gaslight, but that electric motive power is still considerably dearer than gas engine power, leaving out of consideration, of course, the question of convenience and considering merely the relative cost of gas and current. On the other hand it is shown that in many of the smaller cities the electric light is far cheaper than gas, and electric power much cheaper than gas power. In several instances the electric light is successfully competing with petroleum. The results here shown would indicate that the Germans are just waking up to the fact that there is a profitable business to be done in small towns as has been proved to be the case in this country when the stations are properly managed.

Of the cities tabulated, the large majority are operated on the continuous current plan and of these a large percentage are equipped with storage batteries. The figures show that all these stations exhibit by far the greatest economy in fuel consumption. The best result thus far obtained is that recorded of the storage battery station at Altona, namely; .413 kilowatt hour of current delivered to mains for 1 kilogram of coal, that is, close to 4 pounds of coal per H. P. per hour, or 5.3 pounds per kilowatt hour of current delivered. The table of the National Electric Light Association submitted at the last meeting showed an average of 91.7 watt hours per pound of coal and a maximum of 208, while in the case of Altona the economy is 190 watt hours. But the point to be considered is that while the 208 watt hours per pound of coal was obtained with a station having a capacity of 8,000,000 watt hours per day, the 190 watt hours per pound of coal at Altona were obtained with a station of only 468,000 watt hours capacity per day. There is food for thought in this showing and it ought to have some influence on future work in America. We would respectfully suggest to the Committee on Data of the National Electric Light Association a close study of the German statistics which contain much that may be embodied in their own work. We recognize that it is one thing to get up a statistical blank, and quite another to have it filled out properly and returned; but by giving ample time to the companies some improvement over the results heretofore obtained ought to be secured.

GENERAL ELECTRIC AND FORT WAYNE.

THE conflict between the Fort Wayne and General Electric Companies, after occasional outbursts of more or less violence for a year or so past, has now broken out afresh with every mark of a war to the knife. Our columns contain notices of the receivership of the Fort Wayne Co. established a week ago, of the attachment served upon that company in New York by the General Electric Company, as well as a somewhat vehement article from the Fort Wayne. It would be idle now to express an opinion on the merits of the quarrel—but it will be watched with much interest in electrical circles. Mr. McDonald's prowess and fertility of resource are well known and he may be expected to make a strenuous fight to achieve complete independence from control by the General Electric Company.

THE DANGERS OF THE TROLLEY.

Now that the real dangers of the trolley have become recognized proper efforts are being made to meet and remove them; and the remedies can be applied neither too soon nor too thoroughly. Electrolytic action is being dealt with, and there is reason to believe it may be nullified. As for the evils of overhead wires, it is believed that to-day more than one substitute in the shape of a feasible conduit system exists. We are now glad to note that in some cities steps are being taken to subject the motormen to examination, with the object of ascertaining how far their sight may be defective. In Jersey City and Newark some of the men have been found unable to judge distances, and are naturally held to be disqualified for any such service as running cars propelled mechanically along crowded streets. More of this scrutiny might well be enforced. If it is good for steam railroad employés it is better still for those of city surface lines.

STANDARDIZING ELECTRICAL MEASURING INSTRUMENTS.[1]

BY ELMER G. WILLYOUNG.

CONSIDERATION of the liability to variation in instruments with the lapse of time, long ago convinced the author that restandardizing should be done by stations themselves in all cases except when quite small, and that some arrangement of apparatus should be devised which would make the utilization of some absolute standard method inexpensive and convenient, and possible to any one of ordinary intelligence. After a good deal of thought and personal experience, he became convinced that the only method which could be made to at all satisfy these requirements was the potentiometer method. Before describing the improved apparatus which he has devised for the commercial utilization of this method the author discusses briefly the potentiometer method in general outlines and its advantages over other methods.

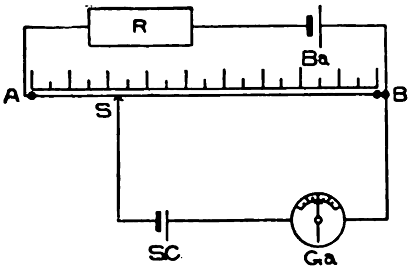


FIG. 1.

The improved, direct-reading potentiometer invented by the author and illustrated in Fig. 3, is capable of being used for measurements of voltage from 0 up to 1,500 volts and of current from 0 up to any required upper limit with a maximum error of not over $\frac{1}{15}$ per cent. It is based upon the form of potentiometer originally suggested by Dr. Fleming, which is shown in diagram in Fig. 1. Some good suggestions were also obtained from the improved form of Mr. Crompton.[2]

A diagram of the arrangement of circuits in the improved form of apparatus is shown in Fig. 2.

The wire A B of Fig. 1 is here equivalented by three sets of coils marked respectively Q, M and S. The regulating resistance (R of Fig. 1) is made up of two parts, one resistance, R, consisting of coils, and the other, R_s, being made up of a bare wire of resistance equal to one of the coils of R_q. This wire is laid back and forth upon about 350° of an ebonite cylinder and has a fixed brush, P, so arranged with reference to it that P short-circuits more or less all of the V's simultaneously, thus giving a large range of variation for a very small angle of rotation. The quick and rough regulation is effected by R, while the finer adjustment is obtained by R_s.[3] The two series of coils, M and S, have at their centres two switches which are in series with the galvanometer and unknown E. M. F.; moving these switches over the coils is exactly the same as shifting the points S and B of the derived circuit in Fig. 1. M is the medium movement, each coil being $\frac{1}{150}$ of the entire resistance between A and B, while S is the very slow movement, each of the nine coils in S being equal to $\frac{1}{10}$ of the resistance of one of the coils of M. In order to get a rate of separation of the two derived circuit terminals by steps of ten times the value of a coil of M, a third series of resistances, Q, is provided. This is a rather peculiarly arranged affair, its function being to take out resistance from between the derived circuit terminals and place it outside, or *vice versa*, the total resistance between A and B remaining always constant. It is evident that this change of resistance from one part of the circuit to the other accomplishes exactly the same result as is obtained by M and S, viz., the separation or bringing together of the two derived circuit terminals. We have, therefore, the entire resistance, A B, divided into 1,500 parts, and the derived circuit terminals separable along this resistance by steps of 100 parts, using Q; ten parts, using M; and single parts, using S. This means an ability to set to 1 part in 1,500 or to $\frac{1}{15}$ per cent.

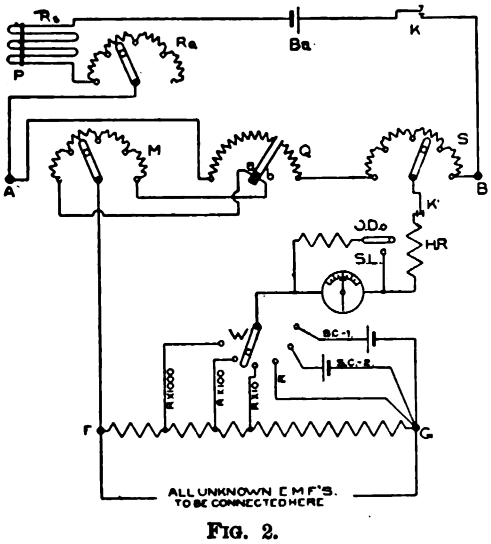


FIG. 2.

In order to make the measurement of any unknown potential convenient and quick, a suitable arrangement of switches is provided. In the lower part of the diagram, R is a high resistance connected between two points, F and G. To F is permanently joined one derived circuit terminal. The other derived terminal passes, by way of a key, K', through a galvanometer and thence to a switch, W, which plays over a number of contact points connected as shown. The two points, S. C.-1 and S. C.-2, are joined each to a terminal of a Carhart one-volt cell, the other terminals of which are joined in common to G.[4] The remaining points are connected to points along F G, dividing the whole resistance in the ratio $\frac{1}{1000}$, $\frac{1}{100}$, $\frac{1}{10}$ and $\frac{1}{1}$. In this way, with W on one or the other of the standard cell contacts, we may by proper setting of Q, M and S, and adjustment of the regulators R_s R_q get the E. M. F. between A and B accurately 1.5 volts; we may, also, compare the two cells with one another, and thus detect any possible variations in either, as the probability that both would change alike, in the event of any change taking place, is extremely small. By now setting W on R any unknown E. M. F. joined to F and G and less than 1.5 volts immediately becomes measureable. Should the E. M. F. be greater than 1.5 volts and less than 15 volts, W is set on R × 10 instead of on R; greater than 15 and less than 150 volts on R × 100; greater than 150 and less than 1,500 volts on R × 1,000. When measuring current leads are brought to F and G from the shunt terminals and the E. M. F. measured like any other unknown E. M. F. In order to avoid the risk of accidentally getting too strong a current through either of the standard cells a high resistance, H R, of about 10,000 ohms is permanently placed in the galvanometer circuit. A shunt is also placed around the galvanometer which may be thrown in or not, as desired, by means of the little switch placed for the purpose.

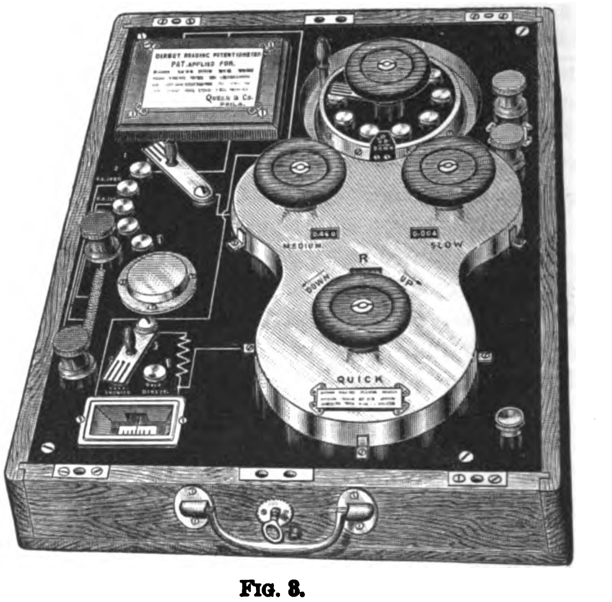


FIG. 3.

The author then describes the method of operation and some of the most interesting details of construction and concludes as follows:

The apparatus is simple and compact and its mode of use can be successfully learned by a schoolboy in a few moments.[5] Being a zero method it is absolutely unaffected by neighboring currents or magnetic fields and the galvanometer being a dead beat and jewel suspended D'Arsonval, may be used under the most severe conditions of mechanical shock and vibration. On board ship it is believed to be absolutely the *only* apparatus which could possibly be used.

---

[1] Abstract of a paper read at the Meeting of the American Institute of Electrical Engineers, Philadelphia, May 17. 1894.

[2] See *Electrician* (Lon.), May 12, 1893, p. 32.

[3] Instead of this form of regulator I have thought of substituting some form of carbon or graphite resistance since all that is needed is invariability for a certain period. E. G. W.

[4] "A One-Volt Standard Cell," by Henry S. Carhart. *Am. Jour. of Science*, Vol. XLVI., July, 1893.

[5] The dimensions over all are 11 in. by 14 in. by 5 in. deep; weighing less than 10 lbs.

LETTERS TO THE EDITOR.

LIGHTING BY RESONANCE.

I have read with much interest the article entitled "Lighting by Resonance," in the last issue of the ENGINEER, but have been puzzled to find an exact place for it in view of what has been done in the past in the field of vacuum glow lighting. If I understand the article referred to, Dr. Pupin has been able to secure by low frequency alternations a rise in potential by grouping an induction coil and a condenser in series, and regulating the induction coil until resonance is obtained.

In his lecture delivered before the Franklin Institute in Philadelphia, in February, 1893, and printed in the "Inventions, Researches and Writings of Nikola Tesla," there is a chapter on electrical resonance, and on page 344 there is shown a diagram with an adjustable inductance coil in series with a condenser for obtaining resonance. How does Pupin's principle differ from Tesla's, leaving out of consideration the question of frequency, which, after all, is only a matter of degree?

On the other hand if, as Dr. Pupin appears to have demonstrated, the necessary glow can be obtained at low frequencies and comparatively low potentials (2,500 volts) why is it necessary for him or Mr. Tesla to employ a more or less complicated and roundabout method when the required potential and frequency can be obtained directly from commercial alternators and transformers that can be bought in the open market?

I am always glad to note progress in electrical work but I fail to see a step in advance in the present instance. Perhaps you or some of your readers can enlighten me on this subject.

LUX.

NEW YORK, June 8, 1894.

IN order to make the purport of our correspondent's remark clearer to our readers we give below the illustration referred to on p. 344, together with Mr. Tesla's explanation of it:

"In Fig. 184 I. is shown a plan which has been followed in the study of the resonance effects by means of a high frequency alternator. C_1 is a coil of many turns, which is divided into small separate sections for the purpose of adjustment. The final adjustment was made sometimes with a few thin iron wires (though this is not always advisable) or with a closed secondary. The coil C_1 is connected with one of its ends to the line L from the alternator G and with the other end to one of the plates c of a condenser $c\,c_1$, the plate (c_1) of the latter being connected to a much larger plate P_1. In this manner both capacity and self-induction were adjusted to suit the dynamo frequency."—[EDS. E. E.]

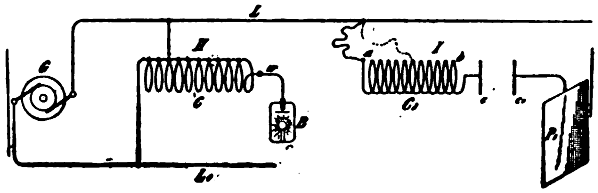


FIG. 184.

THE WEIGHT OF ELECTRIC MOTORS.

PLEASE inform me (1) What would be the lightest possible weight of a 1 H. P. electric motor. (2) About how much space it will occupy. (3) The weight of a 10 H. P. motor.

By supplying the above information you will greatly oblige.

WALTER WORLIN.

MINDEN, NEB.

[1. The weight of a 1 H. P. electric motor would depend largely on the purpose for which it is designed and conditions of use. If self-contained, without bed plate and run not more than, say, 1 hour at a stretch, such a motor could be built, weighing between 40 and 50 lbs. Of course the speed would be very high. For all day service with bed plate a 1 H. P. motor would weigh in the neighborhood of 100 lbs. 2. The actual space occupied would depend entirely upon the design, the cubic contents being between 2 and 3 cubic feet. 3. The weight of a 10 H. P. motor varies with different makes, a good average being about 1,000 lbs.—EDS. E. E.]

WOVEN WIRE BRUSHES.

To make claims for priority, whether in scientific discovery or in commercial inventions, is generally an unpleasant task. In the present case I am compelled to do so, not on my own behalf, but in the general interests of the electrical trade and profession. It has come to my knowledge that it is being claimed that certain broad fundamental United States patents, dated 1889 and 1891, control "all forms of woven wire dynamo brushes," or, as we call them in England, wire gauze brushes. It is my duty to inform all whom it may concern that in the British Patent, 12,372, of Oct. 16, 1885, in the names of L. J. Crossley, W. T. Goolden and myself, for "Improved Means for Regulating the Action of Dynamo Electric Machines," the following passage occurs: "The brush or rubber may be composed of fine wire gauze rolled into a flat mass of the requisite thickness, and to prevent the fraying of the edges we cut the gauze from the sheet diagonally." Perhaps because even in 1885 my dynamos were practically sparkless, I did not perceive the importance of this invention, and unfortunately for me no claim was made in the patent for wire gauze brushes.

Not long ago a similar claim was set up in this country, in ignorance, as in the present case, of my invention. I was unable to write freely to the English technical journals, because professional etiquette in this country strictly forbids all advertisement by consulting engineers, and I am further precluded from discussing my own affairs by my connection with an electrical newspaper.

Wire gauze brushes for dynamos may be made by anybody, for the invention is, and always has been, public property, and for this reason I write this letter.

ALEXR. P. TROTTER.

LONDON, ENG., May 25, 1894.

LEGAL NOTES.

STORAGE BATTERY LITIGATION.

THE argument on the motion of the Consolidated Electric Storage Co. against the Electric Storage Battery Co., manufacturers of the Chloride battery, for a preliminary injunction, was brought to a close on the 7th inst. before Judge Green in the U. S. Circuit Court at Trenton.

THOMSON-HOUSTON CO. vs. WESTERN ELEC. CO.—DYNAMO AND MOTOR REGULATION.

HEARINGS were had last week before Judge Grosscup, in Chicago, in the above suit, which has been afoot for some time, and is based upon the Thomson-Houston regulator patent, relative to the control of the movement of the brushes on dynamos and motors. Barton & Brown are the attorneys for the defence, while F. P. Fish, G. R. Blodgett and Judge Taylor are conducting the plaintiff's case. Prof. Elihu Thomson was in attendance.

LAMP INJUNCTION.—The General Electric Co. has secured an injunction against the Boston Lamp Co., making the Pollard incandescent lamp, in which leading in wires are replaced by conducting strips of glass.

SOCIETY AND CLUB NOTES.

ANNUAL CONVENTION OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The 26th Annual Convention of this Society will be held at the the Cataract House, Niagara Falls, N. Y., beginning at 10 a. m., on Wednesday, June 20th. The final session will be held on Monday, June 25th.

Arrangements have been made to visit the works of the Niagara Power Company, including the power house, turbines of 5,000 h. p. each, wheel pits, tunnel, industrial village, sewage disposal works, etc. Also the mill of the Niagara Paper Company, which is the largest existing single paper mill, and is now using 3,800 h. p. Also the mills supplied by the Niagara Hydraulic Canal. Visits to other points of interest will also be arranged.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BY invitation of a Citizens' Committee representing the scientific and educational organizations of the citizens of Brooklyn, the forty-third meeting of the American Association for the Advancement of Science will be held in Brooklyn, N. Y., beginning with the Council meeting on Wednesday, August 15. The official time given for the Association meeting will be from August 15th to August 24th, inclusive. There will be meetings of several affiliated societies about the time of the Association meeting which will be of special interest to many members of the Association.

Special invitations have been extended to distinguished foreign scientists, and properly accredited members of all foreign National Associations for the Advancement of Science attending a meeting of the American Association for the Advancement of Science are entitled to register without fee as members for the current meeting.

The hotel headquarters of the Association will be the St. George Hotel, Clark St. The meetings will be held mainly in the buildings of the Polytechnic and Packer Institutes, where will be the offices and the rooms for the several Sections.

For information relating to membership and papers, address F. W. Putnam, Permanent Secretary, Salem, Mass. For all matters relating to local arrangements, hotels, railway rates and certificates, address Professor George W. Plympton, Local Secretary, 502 Fulton street, Brooklyn, N. Y.

LITERATURE.

Ninth Annual Report of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts. Boston, January, 1894. (Pub. Doc. No. 35).

In reviewing the report of the Massachusetts Commissioners last year, we remarked that one of its most noticeable features was the evidently very considerable growth of interest among the towns and cities of that state in reference to the municipal ownership and operation of electric lighting plants. Three such municipal plants were then reported as completed and in operation, beside another municipality which owned a distributing plant and bought its electricity from a private company. No new municipal plants have been established since the report of last year, but the towns of Braintree and Peabody have both enlarged their original arc plants and have commenced the supply of private incandescent lamps on an adequate scale. Some half dozen other towns and cities passed votes favorable to municipal electric lighting during the year 1893, but the only ones which appear to be taking active measures to install plants are Middleborough and North Attleborough. Evidently there is a disposition on the part of the taxpayers in most of the towns having the matter under consideration, to hasten slowly, and to ascertain the outcome of three or four years' operations in the municipal plants which have already been established, before committing themselves fully to the scheme.

The balance sheets of the electric companies operating in the state aggregate for the year ending June 30, 1893, as follows:

ASSETS.	
Construction accounts, cash and materials on hand, bills receivable, etc	$14,275,363.23
LIABILITIES.	
Capital stock, bonds, bills payable, etc	$13,502,072.46
Reserve and depreciation fund	218,877.76
	$13,720,950.22
Surplus	554,413.01
	$14,275,363.23
RECEIPTS.	
For light and power and from other sources	$3,438,367.51
EXPENSES.	
For manufacture, distribution and expenses	2,379,252.17
Leaving a balance of net earnings of	$1,059,115.34

Of the 134 companies operating in the state, 6 appear not to have even earned their expenses, while 26 others have not earned enough to justify the payment of dividends. The net profits have increased over the previous year by $104,966.10, but interest charges and dividends have increased still more, so that the entire transactions of the companies for the year show a deficit of $4,832.18.

The aggregate number of commercial incandescent lamps for four years past shows the following increase from year to year:—

Year ending June 30, 1890	118,529
" " " 1891	161,259
" " " 1892	224,966
" " " 1893	266,843

The rate of increase has been much less rapid than during the last than during the preceding year, being only a trifle in excess of 19 per cent.

The gross receipts of the electric companies operating in the state—in round numbers $3,438,000—have now become more than half as great as those of the gas companies, which amounted to $6,182,000 in 1893. The profits divided to the stockholders by the electric companies were, in round numbers, $431,000, while those divided by the gas companies amounted to $1,126,000; nearly three times as much.

We have heretofore adverted to the fact that the returns required from the Massachusetts companies are defective, in that they do not call for a statement of the watt-hours of energy sent out from each station. This renders it impossible to draw any conclusions as to the relative economy with which the different plants are managed. It is probable that many of the station managers are themselves destitute of this information, but if such is the case, the sooner, for their own good, they are made to keep a check on their output, the better. In the absence of such knowledge, the losses in an alternating system of distribution must sometimes reach an appalling percentage, of the total electrical energy generated.

The tabulations of the report are faulty in the respect we have repeatedly pointed out. Few of the tables are footed up, and if one wishes to ascertain the total number of arc or incandescent lamps in use in the state, he has no resource other than to make a laborious addition of the totals of all the individual companies. It is to be hoped that the next report will show some improvement in this important respect. F. L. P.

Traité de Télégraphie Electrique. By H. Thomas. Paris: Baudry & Co., 1894. 902 pages, 6 x 9½. Illustrated. Price, $7.50, cloth.

This work is intended particularly for those engaged in telegraph service and comprises a description and discussion of all apparatus whether employed in telegraph offices or outside of them. It begins with a chapter devoted to the production of the electric current in which we find described the principal types of batteries used in telegraphy, both in main line and local service, as well as the dynamo electric machine, and its applications to telegraphy. Among the latter we notice a description of the Western Union system and one by Picard, which is so arranged that various potential differences to the full limits of that furnished by the machine can be taken off one machine, differing in this respect from the practice heretofore obtaining in America, where each machine only furnishes one potential.

The author then takes up a description of the receiving device, discussing the action of various forms of magnets and describing those of Hughes, Meyer, Wheatstone, Baudot, Siemens and others; then follow chapters on the dial telegraphs and Morse apparatus and various auxiliary apparatus used in offices, such as the switches, galvanometers, lightning arresters, etc. In the description of the Morse apparatus naturally much attention is devoted to the various types of Morse inking registers, which are still largely employed abroad. The author next describes the equipment and installation of telegraph offices, showing various arrangements for main line and way offices, repeating stations, etc. Quite considerable space is devoted to the discussion of the properties of lines and their influence on transmission, including testing in which we find a description of the latest methods for overcoming induction and other disturbing influences.

In describing the relays and transmitting apparatus the author divides them into two chapters, one in which the unidirectional current is employed, and the other in which a reverse current is used, and describing the most general apparatus used in connection with these two systems. Under the head of printing telegraphs we find a very good description of the Hughes system, and under automatic apparatus those of Wheatstone and others. The author then takes up duplex, quadruplex and multiplex systems, which are fully explained and illustrated by very clear diagrams. A separate chapter is also devoted to synchronous multiplex apparatus. The whole is rounded out by three chapters on the construction of aereal, submarine and subterranean lines, in which we find much valuable matter relating to this part of the work.

Although the larger part of the descriptions and methods are those employed in France the author has by no means ignored foreign practice, and has practically limited himself to the description of systems now in actual use, so that, while making a pretentious volume it contains very little, if anything, resembling padding. The illustrations are profuse and especially valuable for the accuracy of the details. The connection of the author with the French telegraph service has naturally given him opportunities for observation, which he has put to good use, and the volume is one which ought to be in the hands of every telegraph engineer.

TRACCION ELECTRICA SISTEMA DE LOVE.

We have received from the Edison Spanish Colonial Light Co., Edison Bldg., New York, a handsomely printed pamphlet entitled as above. The first part of the work is a translation into Spanish of the article on "The Electric Railway of To-Day," by Joseph Wetzler, which appeared in *Scribner's Magazine*, some years ago. Following this is an illustrated description in Spanish of the Love conduit system for electric railways with extracts from various journals on the working of the system in Chicago and Washington.

Mr. Herbert Laws Webb contributes to the *New England Magazine* an admirable popular article on the telephone, beautifully illustrated by a number of sketches, principally the work of that clever painter and black-and-white draughtsman, Mr. H. Dearborn Gardiner.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 5, 1894.

Alarms and Signals :—

Signal Light Fixture, W. Carter. John W. Dawson and J. Meyrick, Jr.' Louisville. Ky., 520,820. Filed Apl. 5, 1893.

Lever Controlling Device, A. H. Johnson, Rahway, N. J., 520,926. Filed Sept. 6. 1893

Adapted to interlocking systems of switches and signals for steam railways.

Electrical Annunciator, F. W. Ross, Boston, Mass., 521,046. Filed Jan. 12, 1894.

Annunciator, T. J. Thompson, Ch'cago, Ill., 521.144. Filed Sept. 30, 1891.

Conductors, Conduits, and Insulators :—

Section Insulator, H. B. Nichols and F. H. Lincoln, Philadelphia, Pa.. 521,124. Filed Jan. 25, 1894.

Distribution :—

Stand for Controlling Electric Circuits, E. R. Knowles. Middletown, Conn., and E. H. Park, Millbury. Mass., 520,788. Filed Mch. 31, 1893.

A controlling stand adapted especially for use in connection with electric search lights.

System of Electrical Distribution, B. G. Lamme, Pittsburgh, Pa., 520,965. Filed Mch. 27, 1893.

Claim 1 follows :

A constant current alternating generator, a series motor in the circuit thereof, a constant current series direct current generator driven by said motor, and translating devices in series with said direct current generator.

Method of Economising the Energy of Alternating Currents, C. F. Scott, Pittsburgh, Pa., 520,970. Filed Aug. 7, 1893.

Employs a main converter with translating devices in its secondary, an auxiliary converter having its primary and secondary in series respectively with the primary and secondary of the main converter, and means for short-circuiting the auxiliary converter.

System of Electrical Distribution of Alternating Currents, C. F. Scott, Pittsburgh, Pa., 521.051. Filed Feb. 26, 1894.

Employs two alternating current transformers with a connection from one end of one coil of one transformer to approximately the middle point of a coil of the other transformer. For transforming currents from one phase to another phase. See E. R., March 14, 1894.

Dynamos and Motors :—

Multiphase Current Motor, L. Bell, Boston, Mass., 520,763. Filed Nov. 4 1894.

Employs a field magnet having a row of poles forming substantially a continuous ring, a winding thereon by which continuous current is passed around the field magnet pole, an independent closed circuited winding in grooves in the pole faces, and a switch to open or close the closed circuit winding.

Method of and Means for Starting Alternating Current Motors, L. Bell, Boston, Mass , 520,764. Filed July 3, 1893.

The method consists in arranging the inducing coils in multiple at starting and throwing them into series when the speed rises.

Armature for Dynamo Electric Machines, H. F. T. Erben, Schenectady, N. Y., 520,773. Filed Feb. 9, 1894.

Claim 1 follows :

In an armature for a dynamo electric machine, a spider having arms extending therefrom adapted to engage the core-discs, such arms provided with an opening, in combination with conductors passing through such openings and commutator segments connected to such conductors.

Electric Truck Motor, J. C. Henry, Westfield, N. J., 520,780. Filed Aug. 27, 1892.

A motor having its field coils wound with a number of parallel conductors, the strand through which the circuit is first completed and last broken being of higher resistance than the others, and a switch on the positive side of the field magnet adapted to close the circuit through one or more of the conductors.

Dynamo Electric Machine, A. B. Herrick, Schenectady, N. Y., 520,781. Filed Jan. 25, 1894.

Claim 1 follows:

The method of simultaneously generating a plurality of currents of different electro-motive forces in a single armature, which consists in rotating such armature in a composite field of force having some of its parts more highly magnetized than others.

Electric Motor, A. Hinman, Olympia, Wash., 520,782. Filed Dec. 14, 1893.

Relates especially to certain mechanical details of construction.

Electric Motor Controller, W. J. Hopkins and T. Stebbens, Boston, Mass., 520.784. Filed Sept. 19, 1891.

The method consists in first connecting the motors in series with a resistance, gradually cutting out the resistance, connecting the motors in multiple, and simultaneously reinserting the resistance in series with them, and finally gradually cutting out the resistance.

Alternating Current Motor, O. Offrell, Middletown, Conn., 520,800. Filed Nov. 29. 1892.

Relates to certain mechanical details of construction.

Electric Reciprocating Motor, E. Thomson, Swampscott, Mass., 520,810. Filed July 10, 1891.

A motor adapted to rock drills, etc.

System of Circuit Control for Electric Machines, C. E. Davis, Chicago, Ill., 520,822. Filed Oct. 16, 1893.

The method consists in breaking the supply circuit, connecting the motors in series on the local circuit including a variable resistance and then causing the resistance to be regulated to suit the requirements.

Dynamo Electric Machinery, C. Sellers, Philadelphia, Pa., 520,940. Filed Oct. 17, 1893.

Claim 1 follows :—

In a dynamo electric machine having a vertical shaft, a cylindrical frame provided with internal projections having bearings concentric with the axis of rotation of the shaft.

Electric Motor for Dental Engines, W. A. Crowdus, Chicago, Ill., 521,138. Filed Oct. 22, 1892.

Lamps and Appurtenances :—

Electric Arc Lamp, L. E. Howard, Plainfield, N. J., 520,991. Filed Aug. 19, 1893.

Claim 1 follows :—

An electric lamp having its burner or source of light surrounded by a transparent envelope coated with a deposit of translucent metallic oxide.

Electric Arc Lamp, L. B. Marks, New York, and C. Ransom, Passaic, N. J., 520,996. Filed Jan. 9, 1894.

Claim 1 follows :—

The method of operating an arc lamp on constant potential circuits which consists in confining the arc within an inclosure, restricting practically all the drop of potential in the arc circuit to the arc and continuously maintaining said drop at a point which prevents an excessive flow of current.

Incandescent Lamp, D. C. Voss, Boston, Mass., 521,181. Filed Nov. 23, 1893.

The invention relates especially to a cement plug composed of the metallic oxides of lead, alumina and manganese blended into a homogeneous cement free from silica, potash, soda and lime.

Measurement :—

Voltmeter, E. R. Knowles, Middletown. Conn., 520,789. Filed Dec. 5, 1893.

Employs a permanent magnet, a spool of non-magnetic material lying transversed to its poles and containing a socket into which a shell is removably fitted having journal bearings for an armature spindle.

Electric Meter, E. Thomson, Swampscott, Mass., 520,811. Filed Feb. 21, 1894.

Employs a series coil, a resistance in series with an armature, and a shunt coil furnishing an initial field sufficient to balance friction of moving parts.

Ammeter, E. R. Knowles, Middletown, Conn., 520,963. Filed Dec. 9, 1892.

Claim 2 follows :

An ammeter having a helix composed of a strip of metal containing two narrow and wider portions one following the other.

Voltmeter. E. R. Knowles, Middletown, Conn., 520,964. Filed Dec. 14, 1893.

Claim 1 follows :

In a voltmeter, a core containing a narrow transverse socket, in combination with a flat frame removably inserted in said socket and containing bearings for the needle spindle.

Electric Meter, W. B. Reed, New Orleans. La., 521,089. Filed Feb. 13, 1894.

Employs two field coils and a rotating armature, and an armature circuit, the field coils being supplied from the positive and negative wires, and the armature circuit from the neutral wire of the system.

Metal Working :—

Electric Heating Apparatus, G. D. Burton, Boston, Mass., 521,099. Filed Aug. 11, 1893.

Relates to special forms of the terminals whereby rods of different sizes may be heated simultaneously.

Miscellaneous :—

Electric Elevator, W. D. Lutz, Philadelphia, Pa., 520,794. Filed March 10 1894.

Relates especially to mechanism for controlling the speed of the elevator.

Electroprotective System for Locks, M. Martin, Malden, Mass , 520,795. Filed Nov. 23, 1893.

Means for Preventing Arcing in Electric Power Stations, E. Thomson, Swampscott, Mass., 520,809. Filed Sept. 1, 1890.

Employs a pipe for discharging a jet of air across the arcing space formed when the fuse is blown, and a valve held under tension in a closed position by an auxiliary fuse wire.

Electric Circuit Regulator, H. F. Waite, New York, 520,908. Filed Jan. 25, 1893.

A regulator for electro therapeutic apparatus.

Connection for Electric Wires, J. Y. De Mott, Newark, N. J., 521,018. Filed Jan. 6, 1894.

Consists of a plate of conducting metal adapted to be clamped about the ends of the wires.

Electric Subway, J. J. E. Philips, Brooklyn, N. Y., 521,125. Filed Aug. 29, 1893.

A subway provided with a track suspended from its upper side and a roller bed running upon the track for the purpose of drawing in cables.

Railways and Appliances :—

Electric Locomotive, W. H. Knight, Lynn, Mass., 520,787. Filed January 18, 1894.

Claim 1 follows:

In a vehicle, the combination with two or more trucks, each having a plurality of separately driven axles mechanically connected together, of means for simultaneously effecting the same change in the motive condition of each truck.

Feed Wire Insulator, C. A. Lieb, New York, 520,855. Filed Apl. 12, 1894.

An insulator composed of a body of insulating material and a metal cap carrying a sleeve for supporting the wire.

Trolley Wire Support, L. McCarthy, Boston, Mass., 520,937. Filed March 3, 1894.

Closed Circuit for Electric Railways, P. Plodeck, Sr., 520,938. Filed Feb. 21, 1894.

A conduit covered by a row of lids which are lifted by the trolley arm as the car passes.

Electric Railway Overhead Switch, M. A. Smith, Brooklyn, and W. Clabaugh, New York, 520 971. Filed Feb. 21, 1894.

Converter System for Electric Railways. G Westinghouse, Jr., and C. F. Scott, Pittsburgh, Pa., 520 975. Filed July 31, 1893.

Provides means whereby the sectional conductors, when not employed in feeding the car motors may be supplied with an extremely low potential, and when the motors are being fed from any given section, the potential supplied thereto may be raised.

Conduit Electric Railway System, J. B. Brand, Milwaukee, Wis., 521,010. Filed March 19, 1894.

Employs a conduit containing a closed tube through which extends a conductor insulated from it, and which has a plurality of contact devices operated by the passing car.

Switches and Cut-Outs :—

Fuse Box, A. Ekstrom, Lynn, Mass.. 520,772. Filed Nov. 29, 1892.

A fuse box having a removable side to which is attached a fuse supporting block and a septum dividing one side of the box from the other when the block is in place.

Lightning Arrester, J. W. Gibboney, Lynn, Mass., 520,776. Filed Feb 6, 1893.

Employs a constantly maintained short circuit composed of liquid flowing from one main line conductor to the other.

Electric Switch Box, E. R. Knowles, Middletown, Mass., 520,852. Filed Dec. 5, 1893.

The invention consists in a double pole snap switch inclosed in a water tight box and having an operating handle on the outside of the box.

Telephones and Apparatus :—

Ear Pad for Telephone Receivers. J. W. Kinniburgh, Wellington, New Zealand, 520,786. Filed Nov. 10, 1893.

THOFERN'S APPARATUS FOR ELECTRO-DEPOSITION.

MR. HERMANN THOFERN has recently patented a method for obtaining a fine and homogeneous deposition in an electrolytic bath. This consists in submerging the cathode below the surface of the electrolyte and subjecting it to a continuous spraying of the electrolyte, which is kept in circulation by means of a pump. The cathode, in the form of a cylinder, is also kept in rotation and the deposited metal is stripped off at the completion of the run.

REPORTS OF COMPANIES.

A BELATED ATTACHMENT OF FORT WAYNE ELECTRIC FOR $500,000.

ACTION BY THE GENERAL ELECTRIC COMPANY.—MR. R. T. MCDONALD NOT CAUGHT NAPPING.

JUDGE ANDREWS, of the Supreme Court, New York city, has granted an attachment for $500,000 against the Fort Wayne Electric Company of Indiana in favor of the General Electric Company of this city for money lent between May 1, 1892, and May 1, 1894. The attachment was granted on the ground that the company is a foreign corporation.

A deputy sheriff served copies of the attachment on the National Broadway Bank and H. C. Adams, jr. It was reported that the Fort Wayne Electric Company had transferred all its property in this city to the Fort Wayne Electric Corporation.

The immediate cause of the attachment was the appointment in the Indiana courts of a receiver for the Fort Wayne Company on Wednesday of last week. The General Electric Company is a stockholder of the concern attached.

An officer of the Fort Wayne Electric Company said that so far as he could see the attachment would not hold, as it was placed on chattels which were the property of another corporation. The opinion was expressed that the validity of the General Electric claim would depend entirely upon the legality or illegality of the transfer of the electric company's assets to the electric corporation.

Our Chicago correspondent, under date of June 7, sends us the following special despatch received in Chicago that day :

Fort Wayne, Ind., June 6.—This afternoon R. T. McDonald, general manager and a heavy stockholder of the Fort Wayne Electric company, asked for a receiver for the plant, valued at $500,000. Superior Court Judge Dawson appointed H. J. Miller of Fort Wayne and E. W. Hawthorne of Boston receivers.

Immediately articles of incorporation of the Fort Wayne Electric corporation, with a capital of $1,000,000, were filed. Messrs. McDonald, Lumbard, Gross, Knight and Miller were named as five directors of the new company.

It is a sensational court matter, and it is supposed the General Electric Trust company was to gobble up the Fort Wayne concern with its branches at Chicago and New Orleans and put the plant undeniably in the hands of the Electric Trust.

McDonald has made this gigantic deal to save the plant and carry on the business with increased capital if necessary. The deal will create some uneasiness in electric-light circles. The Fort Wayne plant is running a full force of hands as usual.

The subjoined remarkable manifestation of local feeling on the subject, we quote from the *Fort Wayne Journal*, of June 7, *in extenso* :—

THE TRUST THWARTED.

FORT WAYNE ELECTRIC COMPANY IN COURT.—RECEIVERS APPOINTED AT THE INSTANCE OF MR. R. T. McDONALD.

IT IS TO PREVENT THE GENERAL ELECTRIC COMPANY FROM CLOSING THE LOCAL WORKS.—A GREAT LEGAL BATTLE ON.

The greatest disaster that has threatened Fort Wayne since its inception, one hundred years ago, is averted.

A movement was on foot to close the Fort Wayne Electric Works and shut 1,200 men out of employment.

A pay roll of $20,000 a month was to be stopped.

Between us and this calamity stands Mr. Ronald T. McDonald.

Arrayed against him is the powerful General Electric Company and the wealth of Wall Street.

In the face of these stupendous odds—odds that would phase any other man than Mr. McDonald—we predict he will win.

This card, published in *The Journal* for a week past, will explain Mr. McDonald's attitude.

STOCKHOLDERS' MEETING.

Notice is hereby given that the annual meeting of the stockholders of the Fort Wayne Electric Company for the election of directors and transaction of other business, will be held at the office of the company, in Fort Wayne, Ind., on Saturday, June 9, 1894, at 2 p. m.

BRAINARD RORISON,
Secretary.

The electric light interests of the country are controlled mainly by the General Electric Company, and that corporation is owned by eastern capitalists. They have absorbed the Brush, the Edison, the St. Paul, the Thomson-Houston and various smaller electric corporations.

The plan pursued by this gigantic Wall Street combine is to close up the shops of competing companies and concentrate them under the direct control of the General Electric Company on their railroad lines, so as to profit by the shipping business.

Some time ago they practically wiped out the works of the Thomson-Houston Company at Lynn, Mass. and removed them to Schenectady, N. Y. on the line of the New York Central road.

Holding a controlling stock interest in the Fort Wayne Electric Company the scheme of the eastern fellows was to assume control of the local plant at the annual meeting Saturday next, close it up shut the men out and transfer the manufacturing business to Schenectady, N. Y. as they have done with other corporations.

Anticipating this movement, Mr. McDonald applied to the Supreme Court, yesterday, for the appointment of receivers for the Fort Wayne Works.

Mr. Henry J. Miller and Mr. E. J. Hawthorne were selected by the court to take charge of and operate the Fort Wayne plant. They qualified and gave bond in the sum of $60,000 for the faithful discharge of their trust with D. N. Foster, George W. Pixley, R. L. Romy and J. F. William Meyer as sureties.

Simultaneous with the filing of his application for receivers Mr. McDonald organized and incorporated the Fort Wayne Electric Corporation, capital stock $1,500,000 the first holders being R. T. McDonald, Charles C. Miller, S. C. Lumbard Charles S. Knight and M. C. Gross.

The Corporation has contracted with the receivers to continue the business of the Fort Wayne Electric Company and the compact has been sanctioned by the court.

The assets of the Fort Wayne Electric Company are sufficient to pay all of its debts and leave a considerable surplus for distribution to its stockholders, so that no man will lose a dollar.

The capital of the new company is ample for its purposes, and the arrangements they have made are such that no sacrifice in respect to the assets in the hands of the liquidators will be necessary.

Thus, Phœnix-like, rises out of the wreck contemplated by the combine a new company, with a business as broad as the land and branch offices at 44 Broad street, New York ; 185 Dearborn street, Chicago ; Philadelphia ; Pittsburgh ; San Francisco ; New Orleans ; Dallas, Tex. ; Syracuse, N. Y. ; Portland, Ore. ; Columbus, Ohio ; City of Mexico, Mexico ; Havana, Cuba, and various smaller points, to compete with the General Electric octopus and defy its power.

Mr. McDonald is doing this for Fort Wayne, for the men who subscribed $25,000 when the integrity of the company was threatened some years ago ; he is doing it for the 1,200 employés of the works and their families ; he is doing it for his fellow citizens, for his friends and his home, at a time when he could dispose of his interests at his own price and continue with the General Electric Company at his own salary, with headquarters in New York.

A great legal battle is on and in the struggle for the life of the Fort Wayne Company, Mr. McDonald can rest assured of the sympathy, support and good will of the citizens of Fort Wayne, who are sure to appreciate his loyalty to the metropolis of northern Indiana.

The latest developments are given in the following dispatch, of Sunday last :—

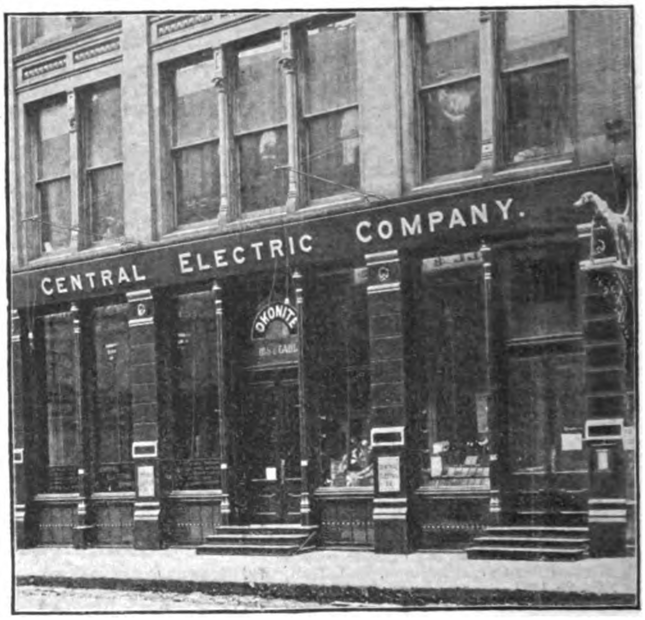
FORT WAYNE, Ind., June 10.—Judge Dawson of the Superior Court, on petition of receivers of the Fort Wayne Electric Company, yesterday issued a temporary injunction and restraining order to prevent the stockholders of the company from holding an annual election yesterday, and also to enjoin them from attaching property in other States which now legally belongs to the receivers. This is to hold off the half million attachment in New York.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

NEW HEADQUARTERS OF THE CENTRAL ELECTRIC COMPANY, CHICAGO.

WHEN a little over seven years ago a new firm engaged in the electrical supply business in Chicago, with rather modest quarters at 38 La Salle street, a good many wiseacres dubiously shook their heads, wondered where the new comers would get their business and predicted that the concern would not last long. In spite of these predictions, however, the business of the new firm grew and prospered so that but a year had passed when larger premises had to be secured, the company moving a few doors south to No. 42, where, with a three-story and basement building, they were better able to meet the demands of their constantly growing trade. Less than two years sufficed to demonstrate that still more room and better facilities were needed, and on Jan. 1, 1890, the Central Electric Co., by this time recognized and acknowledged as one of the leading supply houses of the West, took possession of the building at Nos. 116 and 118 Franklin street, where for over four years the well-known "Okonite" sign was a familiar feature to the electrical people of Chicago and other cities. That in spite of the universal business depression of last year the Central Electric Company should once more find it necessary to seek larger quarters and better facilities for handling goods, speaks volumes for the business sagacity, enterprise and management of the two gen-

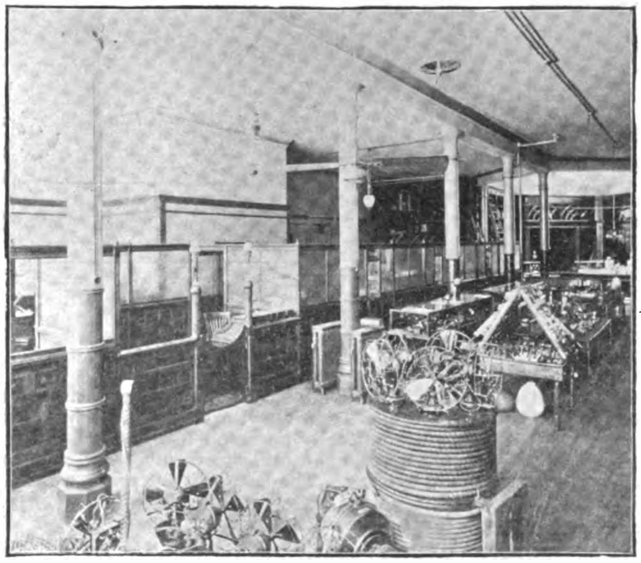


NEW HEADQUARTERS OF THE CENTRAL ELECTRIC COMPANY, CHICAGO.

tlemen at the head of this popular concern. Mr. Geo. A. McKinlock, the president, has been connected with the company since its inception and is so well known to the entire electrical fraternity that a repetition of his personal history seems superfluous. In his endeavors to make the Central Electric Company the leading electrical supply house of the country he has been ably seconded by Mr. Chas. E. Brown, who, beginning as salesman six years ago, has by energy, perseverance and unqualified business ability become the secretary of the company.

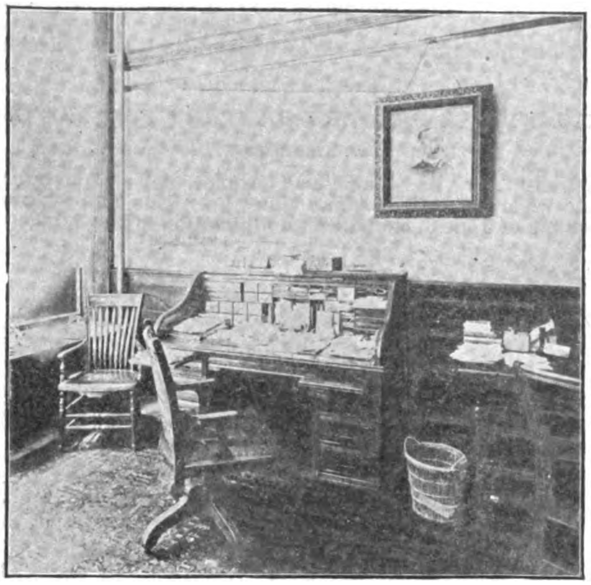
Central Electric Co.—Retail Department.

One of the most potent factors in the steady growth of the company's business is the fact that besides carrying at all times a complete line of first-class staple goods, they have always handled only standard specialties of the highest grade, nothing of doubtful merit being ever allowed a place in their stores. The Company since their start, have been the Western Agent for the Okonite products, and so well has that part of their business been handled that to-day the word Okonite has almost become a synonym for high quality where insulated wires or cables are concerned. The company is also general western agent for the Interior Conduit & Insulation Company's goods, including the well-known Lundell motors and dynamos. It also makes a specialty of the celebrated Helios arc lamps for direct and alternating currents and the new Pharos incandescent lamp, the latter being manufactured especially for this company. The company has its own factory (at Columbus, Ind.) for making white oak cross arms, pins and brackets. It is also agent for the Washington Carbon Company, and of course handles a most complete line of electrical and kindred supplies from a push button to a submarine cable.



Central Electric Co.—Part of Salesroom, Showing Offices.

A complete description and illustration of their new quarters is entirely beyond the scope of a newspaper article, and we therefore confine ourselves to a brief mention of the principal features. In a former issue of The Electrical Engineer, we mentioned their new location at 173–175 Adams St. Our illustration gives an excellent view of the exterior of the main store. This is the large and commodious building formerly occupied by the General Electric Company. It fronts 50 ft. on Adams St. and runs back to the alley, a distance of 175 feet. The large and commodious salesroom is on the ground floor, our illustration giving a view of the retail department on one side and the conveniently arranged general and private offices on the other. The basement and second floors contain the stock in bulk, a complete list of which fills a quite formidable volume, which might be more aptly termed a cyclopædia than a catalogue. In the rear of the main floor the shipping and receiving rooms are located, both opening on the alley north of Adams street and connected with the upper and lower floors by large elevators. Throughout the entire establishment everything is arranged and classified in a systematic manner, and all needed facilities are provided for the quick handling and shipping of orders. As may be imagined, the several departments are in charge of able and efficient lieutenants, among whom may be mentioned Mr. Chas. G. Burton, in charge of conduits and electric lighting, W. R. Pinckard, house goods, and Geo. W. Vernor, cashier. As our readers no doubt know, the company have branch houses at St. Louis and Kansas City, Mo.

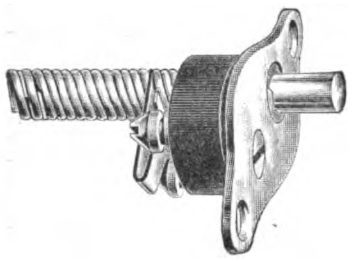


Central Electric Co.—A Corner in the President's Private Office.

CANADIAN NOTES.

The Allgemeine Elektricitaets-Gesellschaft, of Berlin, Germany, has appointed the firm of Munderloh & Co., of Montreal, sole agents for its manufactures in Canada. This German company enjoys a universal reputation for the excellence of design and construction of its electrical apparatus and machinery, of which it is one of the largest manufacturers in the world. All kinds of electrical machinery and supplies are made by the company, including dynamos, motors, complete electric railway equipments, insulated wires, arc lamps and the A. E. G. incandescent lamps. Over 10,000 of these high grade incandescent lamps are turned out daily, and even this large output is to be doubled to meet the demand. The company also make a specialty of alternate current machinery for long distance power transmisson, in which branch it was a pioneer, having undertaken and carried out in connection with the Oerlikon Works, the transmission from Lauffen to Frankfort, a distance of 112 miles, the success of which first demonstrated practically the possibilities of electricity in this direction. Messrs. Munderloh & Co., though new to the electrical trade, have been long established and are favorably known to the commercial world. They have secured the services of Mr. John A. Burns, as manager of the electrical and mechanical department of their business.

THE GEARY & MOSSOP DOOR SPRING.



The Geary & Mossop Door Spring.

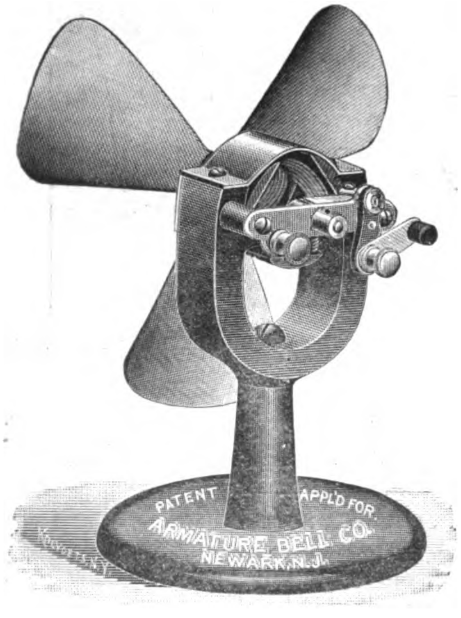
THE door spring shown in the accompanying illustration is one of the latest products of Messrs. Geary & Mossop, of Chester, Pa., of which Mr. Craig R. Arnold is the selling agent. This spring is constructed on new principles, avoiding the use of such metals as will rust and corrode, affecting the efficiency of the device. The principal deviation is the use of a long phosphor bronze spring, one end of which is fastened in the brass head plate which secures it to the door; the other end of the spring has a small brass washer fastened to it, and located between these ends is a German silver contact strip which is bent in the form of a loop, thus giving great flexibility to the contacts. The binding screws have conical heads and the German silver tongue makes or breaks the circuit as desired between these screws. The wires are fastened under the heads of the latter.

Should these heads become worn in time by use they are readily changed to a new position, presenting a fresh surface for contact. The use of the phosphor bronze spring in this shape, secures noticeable advantages. Instead of the pin being rigid, it is very flexible and the German silver tongue is readily changed from one turn to another, which tightens or loosens the contacts as desired. Another advantage that will be appreciated by artisans is the fact that a single bit bored into the frame will admit all of the apparatus, no chisels or other tools being required. The hole which admits the insulating head leaves ample room for the wires to be connected.

HILLHOUSE PRIMARY BATTERY FAN MOTOR.

A CORRECTION.

Through some regrettable inadvertence, not clearly traceable, the notice of the Hillhouse Fan Motor printed in THE ELECTRICAL ENGINEER of June 6, contained an illustration of the Lundell Fan Motor made by *Interior Conduit & Insulation Company*. Herewith is the cut of the Hillhouse machine. The error was entirely the fault of THE ELECTRICAL ENGINEER and was in nowise due to the *Armature Bell Co.*, makers of the Hillhouse Fan Motor. This correction is especially called for in view of the remarkable claim that the Hillhouse 8" Fan Motor runs at a high rate of speed by the application of less than one watt.


PATENT APPL'D FOR.
ARMATURE BELL CO.
NEWARK, N.J.

HILLHOUSE PRIMARY BATTERY FAN MOTOR.

SALE OF THE SHAVER TELEPHONE PATENTS.

Notice is given that the Receiver of the Shaver Corporation, will sell at public auction, at No. 7 Broadway, on the 19th of June, at 2 P. M., all the patents, patent rights, and other property of the Shaver Corporation, including all the right, title and interest of said corporation in territorial leases and other contracts, as well as its entire stock of telephonic and other equipment.

MOORE ELECTRICAL ADVERTISING SYSTEM.

A striking amplification of the electrical display system of D. McFarlan Moore which we described on May 10, 1893, is that embodied in the show wagon of the manufacturers of "Soapine."

Miniature incandescent lamps are arranged at about 2½ inch centres over the entire surface to be used as a sign and placed in the centre of the truck.

The curtains surrounding the driver's seat also enclose the batteries. a small operating board, which consists of as many circuit closers, arranged in push-button form, as there are lamps, and the operator.

The operation of the device consists in utilizing only such lamps, by means of the push-buttons, as are required to produce a specific effect, all of the other lamps remaining dark. When it is desired to change the design the lever on the operating board is thrown, which returns all of the push-buttons to their normal positions and all of the lamps are out, but ready to be lighted again so as to produce any design desired.

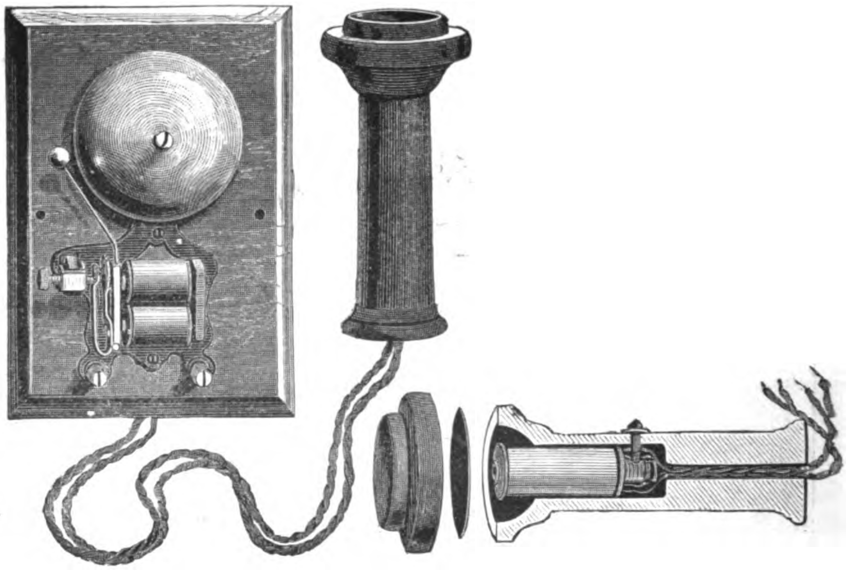
It is evident that the driving of a vehicle of this nature through the principal thoroughfares at night with its brilliant and constantly changing illumination and advertisements, will attract marked attention.

THE INGERSOLL "PEERLESS" TELEPHONE OUTFIT.

A very neat little telephone outfit for private lines is being introduced by Messrs. Robert H. Ingersoll & Brother, of 65 Cortlandt street, New York. It consists of two receivers, which serve also as transmitters, two call bells, two cells of dry battery, 50 feet of annunciator wire, 150 feet of galvanized iron line wire and six insulators.

One of the station sets is shown in the accompanying illustration.

The call bell is of a special type and made solely for this outfit. That ordinarily furnished with this outfit is constructed to ring for a distance of one mile and under, but bells of greater capability are furnished with outfits for long distances. The bell is mounted on a polished hardwood backboard, and the whole is handsomely finished. Though the outfit is very cheap, it is also neat and attractive in appearance. From the board the receiver and transmitter is suspended by telephone cord and at the back of the board, concealed from view, are the switches and connections, which are automatically operated by two push buttons at the side, one to ring up and the other to connect the telephone with the line wire and battery. The batteries are made especially for the "Peerless" outfit with a view to long life and strength.



THE INGERSOLL "PEERLESS" TELEPHONE OUTFIT.

The makers guarantee the outfit to work perfectly over 1,500 feet of No. 18 copper, or No. 10 iron, wire. By adding an extra battery to each end they extend this guarantee to ½ mile, and with another battery added to each end, to one mile. The set is simple, well adapted to short lines, and should find a ready sale.

ALBERT LEA, MINN., has started a Strowger telephone exchange, with an initial list of 50 subscribers. The plant is due to the energy of Mr. Frank B. Forbes, lately the treasurer of Freeborn county.

QUEEN & CO.'S NEW RESISTANCE STANDARDS.

Of all electrical standards that of resistance is the most important, because it can be put in portable, concrete form and is capable of accurate reproduction, providing sufficient precautions are taken. The principal difficulties experienced in making such satisfactory resistance standards are two—lack of permanency in the standard and the effect of temperature upon its value.

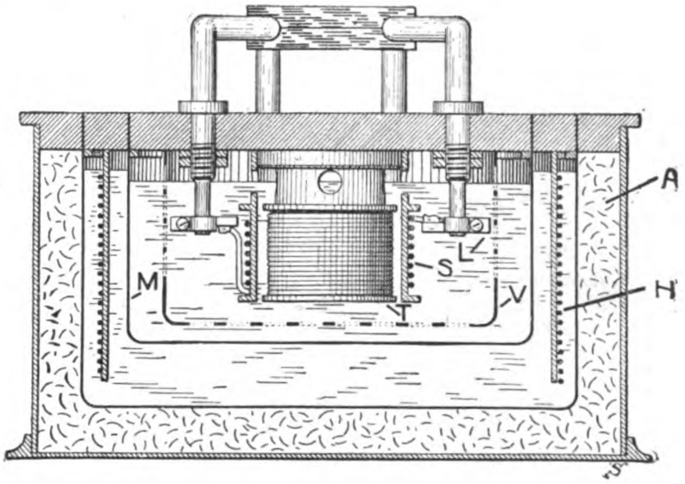


Fig. 1.—Queen & Co.'s New Resistance Standard.

A new standard coil intended to be free from these objections incident to previous forms has been evolved from the laboratory of Queen & Co., Philadelphia. It is of the oil immersion pattern, embodying features adopted by the German Reichsanstalt, but with important modifications of their own, rendering it more constant, accurate and convenient.

Fig. 1 shows a section through the centre. s, the standard coil made of platinoid, is wound on a metal cylinder, the surface of which is covered with a thin coating of insulating material. On a similar cylinder inside of and concentric with the standard coil, is wound the temperature coil T, similarly insulated. These two coils are immersed in a bath of specially treated resin oil contained in the chamber M. It will be noticed that the coils S and T are wound between the same limits of height and depth, and that the casing V is perforated with many holes so as to allow the utmost freedom of circulation to the oil. M, in turn, rests in an oil bath and is surrounded by the concentric thin cylinder on which is wound non-inductively a coil of copper wire H. This wire is placed in series with a generator of some sort and an adjustable resistance serves to maintain the temperature at any desired point.

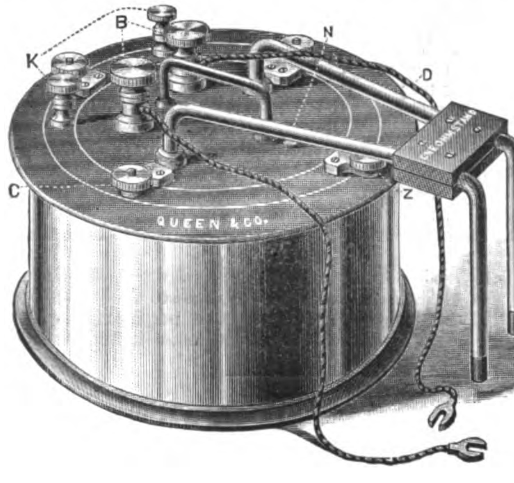


Fig. 2.—Queen's & Co.'s New Resistance Standard.

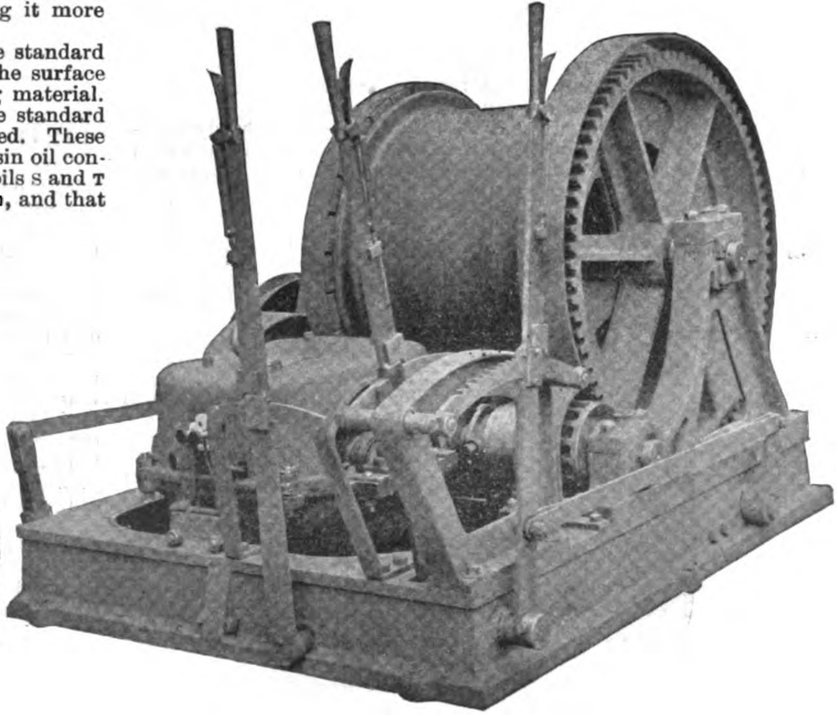
Those who have made use of the oil bath and gas flame for this purpose can appreciate how great an improvement is the electrical method of heating for both constancy and convenience. The heat produced by H is equalized over the surface of M, and thence conducted to the interior parts. A double walled containing vessel with a space between the walls stuffed with asbestos, as shown at A, serves to render the apparatus independent of external heating or cooling effects. This point is of great importance where work of great accuracy is to be done. The ends of the standard coil are soldered to the inner ends of the terminals which are made of massive copper similar in design to the standard British Association ohm.

The design of the temperature coil is very ingenious. It is composed of copper and platinoid, the proportion of the total resistance supplied by each metal being so adjusted that for each degree centigrade rise in temperature the temperature coil increases its resistance 1·20 of one ohm, measured in terms of the standard (*i. e.*, measured by the standard without correcting for its temperature).

Fig. 2 shows an exterior view of the standard. D is a flexible wire serving to connect one of the terminals B, of the temperature coil to whatever apparatus is used for the measurement of the resistance of that coil. The other terminal is exactly similar. K K are two terminals of the heating coil. The whole apparatus is readily dissectible. By unscrewing two nuts and lifting on the handle in the centre, the plate which holds the standard and temperature coils can be lifted out and both exposed to view. By unscrewing two other nuts the heating coil can be lifted out. A very slight alteration of the design for the standard ohm makes a most desirable arrangement for the very important measurement of the temperature co-efficient of metals.

GENERAL ELECTRIC IRON-CLAD MOTOR HOIST.

The General Electric Company mindful of the fact that he who is at first satisfied with something merely good, soon clamors for a change to excellence, has perfected its electric hoists, making them stronger, simpler and more compact. They are operated by motors of the railway type, in which all the moving parts are thoroughly protected. The motor and the hoist are mounted on the same bed plate to which all bearings, levers, quadrants and other connections are attached, making the machine complete in itself. The drum is provided with a powerful hand brake lined with wood and operated by a lever, and is thrown in or out of gear by a friction clutch of positive and reliable type, operated also by a lever. The motor is controlled by a rheostat of the standard type which is thrown in or out by a lever. The pinion on the armature shaft and the intermediate gear with which it engages, have machine-cut teeth and are enclosed in an oil-tight casing. The electric parts of the hoist are thoroughly insulated. These hoists are made in sizes of 4, 10, 15, 30, 50 and 90 H. P., as usually rated.



General Electric Iron-Clad Motor Hoist.

The General Electric Launch Company is building at Morris Heights, on the Harlem River, an electric launch for Congressman Sorg, of Ohio. The launch is to be 46 feet over all, carrying two motors, twin screw and 144 cells of the Consolidated Electric Storage Company's battery, and will have a speed of 12 miles an hour.

THE SCHUCKERT SEARCH LIGHT AT SANDY HOOK.

The great Schuckert search light, which was stationed on top of the Liberal Arts Building at the World's Fair, has now been mounted by Mr. F. Tischendoerfer on a 100-foot tower at Sandy Hook, where the searching power of its beam is attracting much attention among mariners.

NEW YORK NOTES.

Geo. L. Colgate Company, manufacturers, 136 Liberty street, have bought from Mr. W. A. Vail all right, title and interest in the well-known "Swinging Ball Lightning Arrester," which is now in actual use by 1,000 central stations. It has been greatly improved and cheapened in price, though not in quality, and has a remarkable record as a line saver and property protector. The Colgate Co. will be glad to correspond with central station managers in regard to this or any other supplies.

Prof. E. P. Roberts, of Cleveland, accompanied by Mr. Wilson, was a visitor to New York last week. He informs us that the correspondence school in engineering that he presides over is most successful and growing daily. The engineering firm of E. P. Roberts & Co. has taken into partnership Mr. W. B. Stewart, who has had 29 years' practical experience in steam engineering and general machinery, and eight in electric lighting and railroad work. In the consultation line the firm have recently had entrusted to them the preliminary estimates for a 30-mile electric road and the designs for a 15-ton elevator, etc. The firm's headquarters are in the Brainard block, Cleveland.

A NEW PACKARD CONVERTER CUT-OUT.

The Packard Electric Company have recently designed and placed on the market in connection with their Packard transformer a new transformer cut-out which cannot fail to be of interest to every person at all interested in alternating current work.

The difficulty in securing a desirable transformer cut-out has been to make it perfectly safe and convenient to handle and at the same time secure an absolute and sufficient electrical contact and a suitable system of fusing the removable part of the cut-out.

That the Packard Company have succeeded in securing the desired results is very clearly set forth in the accompanying cuts. The engraving Fig. 1 shows the manner in which the fuse plugs project from the front of the case so that they can be easily withdrawn or replaced. Protection is afforded by a hinged cap which entirely covers and conceals the porcelain handle. Thus the transformer can be cut out of circuit and a burnt-out fuse replaced without the use of any tool whatever. The plugs are made interchangeable so that a new plug can be slipped in, in place of the old and the old plug can be re-fused for use again at any time.

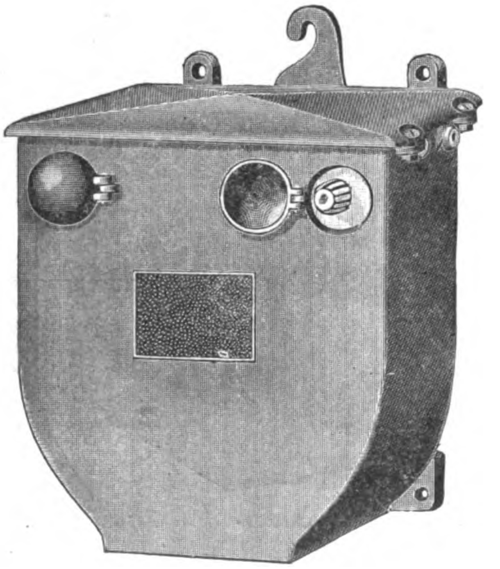
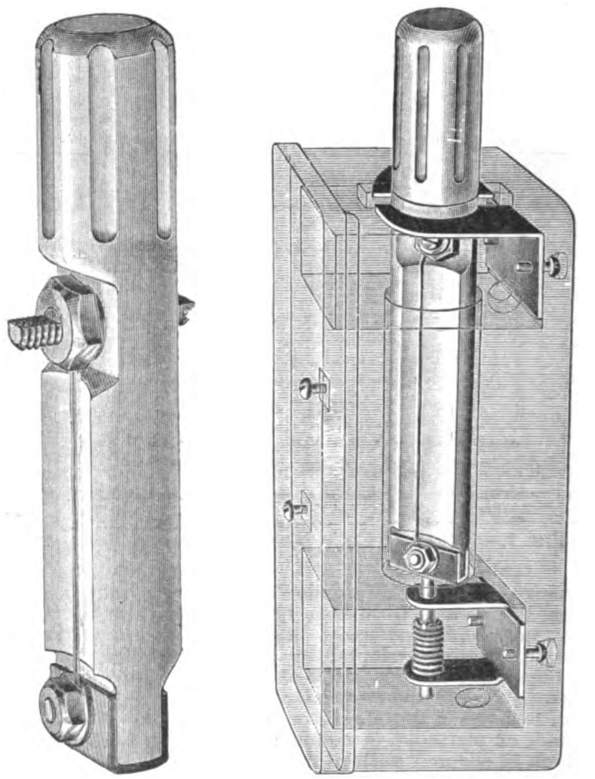


Fig. 1.—A New Packard Converter Cut-Out

Referring to the plug, Fig. 2, it will be seen that the fuse lies along almost the entire length of the plug on one side which has been recessed to allow a groove for the fuse strip where it will be safe from mechanical injury in withdrawing or replacing. The plug is provided with two metal lugs between which the fuse is connected. One of the lugs covers the entire end of the plug; the other extends entirely through the plug making a double contact with its corresponding metal surface within the cut-out block. The cut-out block is a sufficiently heavy piece of porcelain to insure it against breakage in case the transformer should suffer from rough handling.

Divided by a thick porcelain wall two compartments are seen at either end of the block, Fig. 3; in these is made the contact with the two ends of the plug. To insert the plug it is held with the projecting lugs in a perpendicular position so that they will pass through the slots shown in the first contact plate within the block. As the end of the plug comes in contact with the rod carrying the spiral spring in the second compartment, a slight pressure is necessary. This forces the spiral spring back, making a perfect contact with the metal rod at that end, and allowing the double lug of the plug to pass through the two slots in the first contact plate above mentioned. A quarter turn to either the right or left throws the double lugs firmly against the first contact plate where they are held by the pressure of the spiral spring at the other end of the plug. It will thus be seen that a perfect contact is assured at both ends of the plug. The fuse box and plug are both made of the very best porcelain, vitrified and highly glazed and are made sufficiently strong to prevent breakage under ordinary conditions.



Figs. 2 and 3.—New Packard Converter Cut-Out.

The Packard Electric Company and the Electric Appliance Company who are their general Western agents feel confident that the new plug will add greatly to the popularity of the Packard transformer which has already established a good reputation.

WESTERN NOTES.

The Electric Appliance Company have received among their numerous testimonials on this specialty a letter from one enthusiastic customer who says that with the Allen soldering stick they can solder everything; that they are even able to solder common iron spikes solidly together without filing the surfaces in any way.

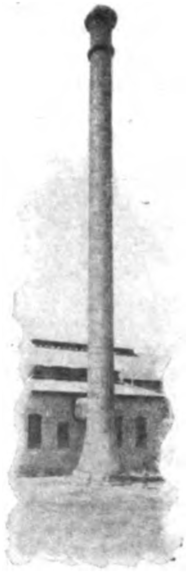
Scenic Theatres.—The Electric Appliance Company are calling attention to the fact that the wonderful effects in fancy illumination which form such an attractive feature of the Masonic Temple Roof Garden and Scenic Theatre are produced entirely by Packard lamps furnished by the Electric Appliance Company. Several thousand Packards of all sizes, shapes and colors are used in producing the beautiful effects.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVII. JUNE 20, 1894. No. 320.

THE NEW CENTRAL STATION OF THE ELMIRA, N. Y., ILLUMINATING CO.

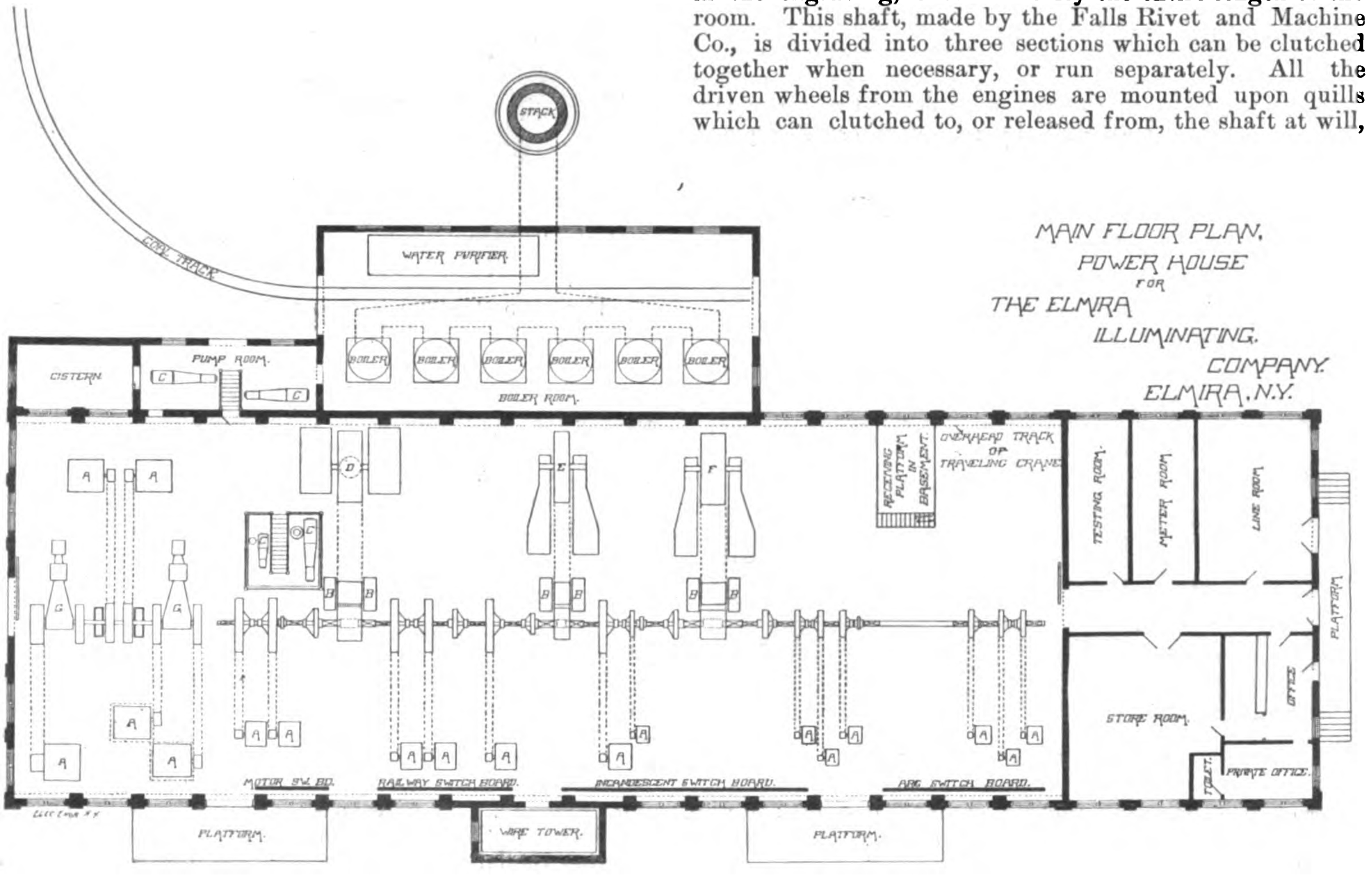


N an industry whose very name is synonymous with progress it is not surprising that each successive step should be a distinct advance—that the experience of other workers in the same field should lead the electrical engineer who is about to design a fuse block or build a city plant, to improve to a greater or less extent upon existing methods, and not only bring his work up to date, but set a new and advanced standard. The new station of the Elmira Illuminating Co., at Elmira, N. Y., is in this respect a modern and a model station, and reflects great credit upon Mr. F. A. Cheney, under whose personal supervision it was designed and erected. Before starting upon a description of the station and its apparatus, however, two items may be mentioned that it would be well for every station superintendent to make careful note of. They are the things that at once strike a visitor and are of more vital importance than might appear on the surface. The first of these is the absolute cleanliness that prevails in the station and around it. There is really no excuse for a dirty station. In fact, the accumulation of dirt requires an expenditure of energy that might with greater advantage be otherwise applied. Cleanliness, as a dividend raiser, is a subject worthy of distinguished consideration. The second item is one that is perhaps more noticeable, because less customary, than the first, and is the perfect "man-o'-war" discipline that prevails among the employés. Each man has his appointed post and is responsible for just so much and no more, and everything is in its place and under the control of the proper persons. There is thus no clashing of authority and, in case of emergency, no confusion.

The new station shown both in perspective and plan, consists of a main building 219 feet long by 66 feet wide, and a boiler room 75 by 36 feet constructed entirely of brick, stone and iron with the exception of the floor, which is made of solid wood seven inches in thickness, resting on steel beams. The roofs of the building were furnished and erected by the Berlin Iron Bridge Co. and are covered with anti-condensation roofing, with turret ventilators extending the entire length of both machine and boiler room. The same company also furnished the traveling crane for the machine room.

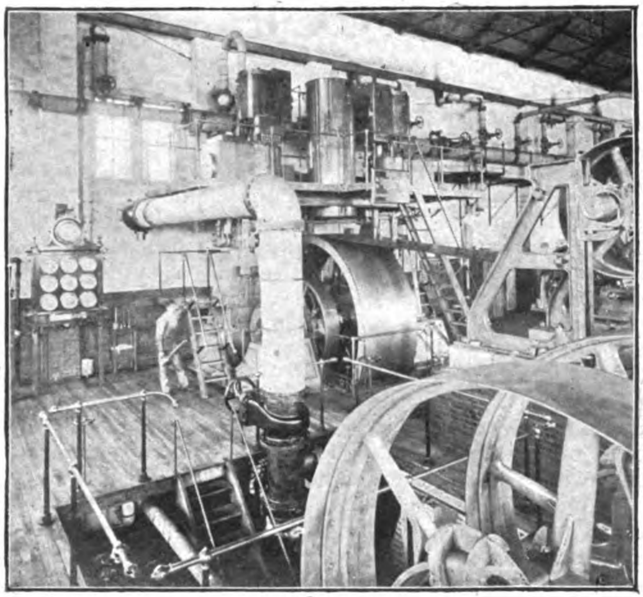
Entering the building from the south, one finds first a spacious room 175 feet long by 64 feet in width in which are placed the engines, shafting and dynamos.

The main shaft, mounted on iron floor stands, as shown in the engraving, extends nearly the entire length of the room. This shaft, made by the Falls Rivet and Machine Co., is divided into three sections which can be clutched together when necessary, or run separately. All the driven wheels from the engines are mounted upon quills which can clutched to, or released from, the shaft at will,



PLANT OF THE ELMIRA ILLUMINATING COMPANY'S NEW CENTRAL STATION.—PLAN.

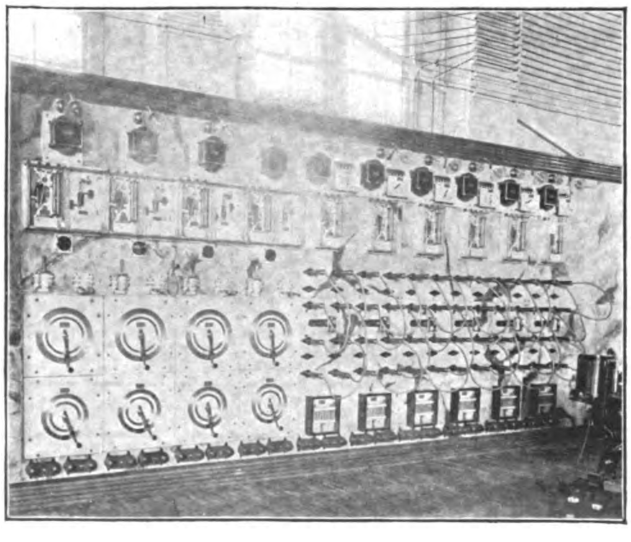
thus permitting the starting or stopping of any engine without interfering with the running of the lights; and all pulleys on the shaft are provided with friction clutches.



Dynamo Room Showing McIntosh & Seymour Triple Expansion Engine.

The entire shaft is a beautiful piece of work. On the left of the shaft are located all the dynamos, designated by A on the plan, while the engines are upon the right. Ample room is provided for all machinery as well as extra room for additional machines and engines.

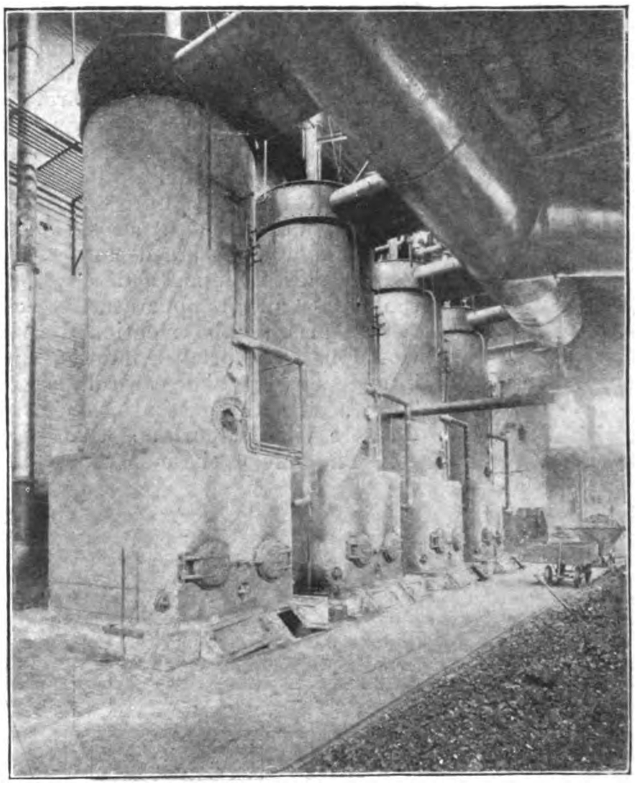
The arc dynamos are seven in number with a capacity of 350 lights. Next beyond these are located the alternating current incandescent dynamos with a capacity of 10,000 lights, while at the extreme end of the room are placed the engines and dynamos for furnishing power for railway and stationary motors. This part of the plant is in duplicate so that in case of a possible accident there will be no interruption of the street car and motor service. These generators are driven by two McIntosh & Seymour compound condensing railway engines, G G, of 350 H. P. each, and Westinghouse multipolar and Edison generators are used.



One of the Switchboards.

Passing around the north end of the line shaft the visitor comes to the McIntosh & Seymour vertical triple expansion four cylinder condensing engine D, a magnificent piece of work alone well worth a trip to Elmira to see. The next engine, E, is a Payne horizontal, triple expansion four cylinder, condensing engine, and is used for light loads, while the next two and last, F, are non-condensing Buckeyes used only for reserve and emergency. The total engine capacity is 2,200 H. P.

The steam piping throughout the station is especially noteworthy, and great care and pains have been taken to overcome the many inherent difficulties in this class of work. The main steam pipe is twelve inches in diameter, made of cast iron, flanged and bolted together. Chapman bronze sealed high pressure valves have been used throughout, and special provision has been made for expansion. So well has the work been done that not the slightest steam leak has yet occurred, although the working pressure is 160 lbs.

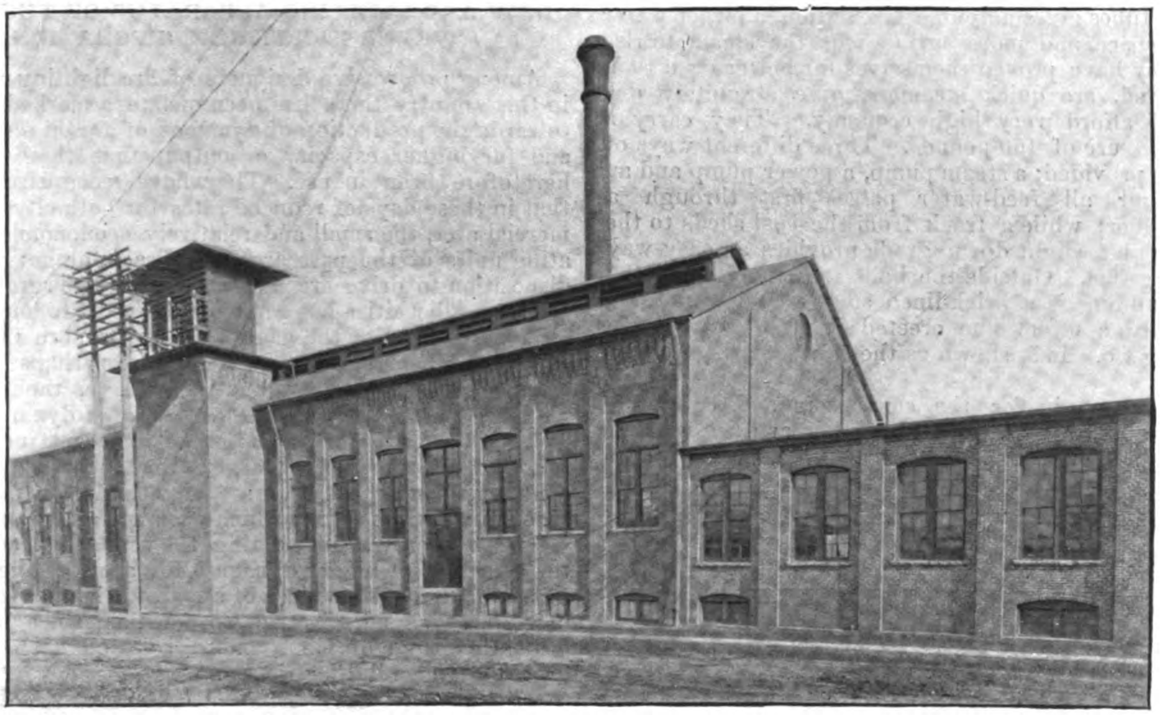


Hammond Manning Vertical Boilers in the Elmira Central Station.

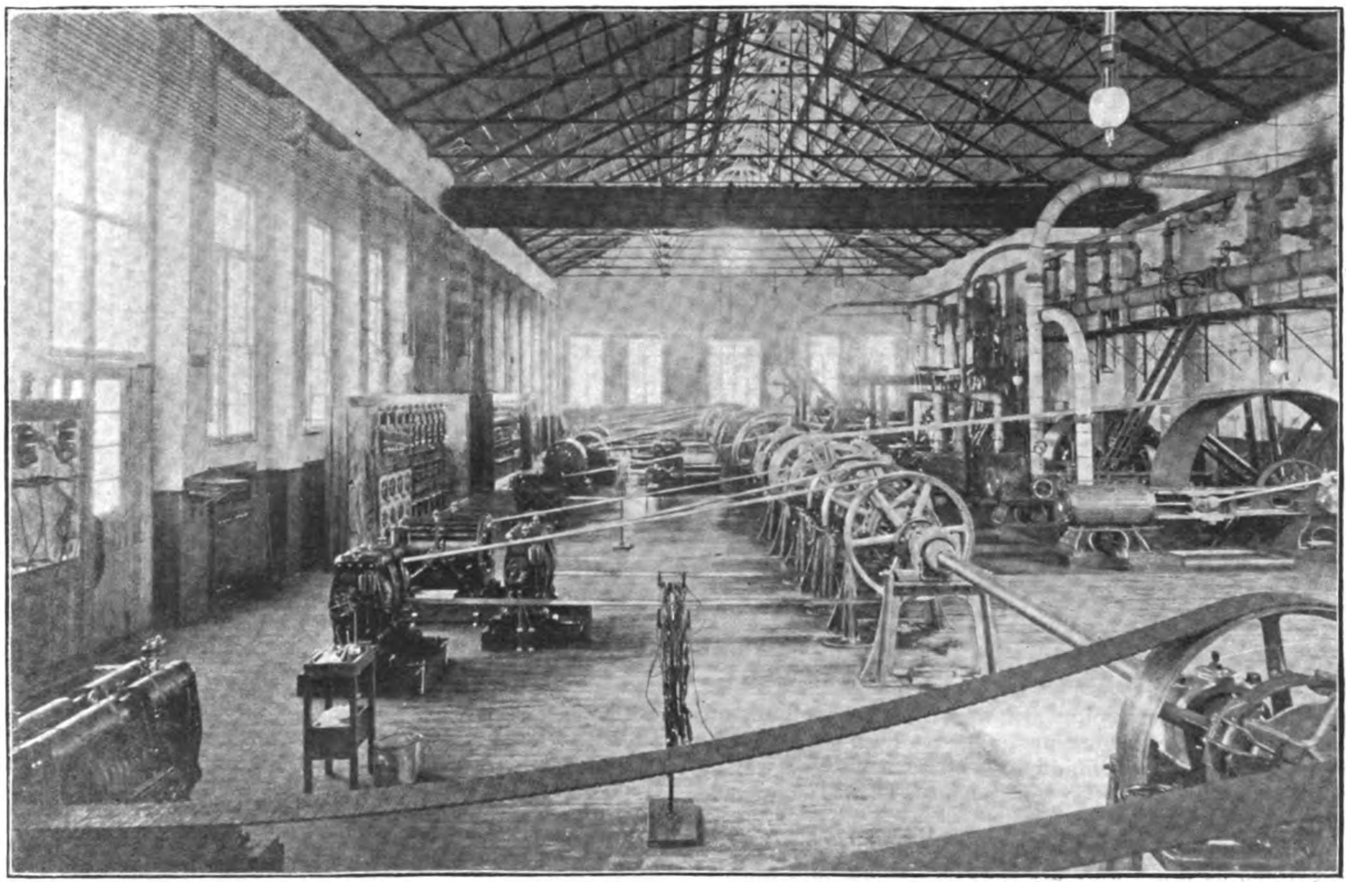
Upon an overhead track supported by the side walls, twenty feet above the floor, is the traveling crane already referred to. This has a capacity of ten tons, and traverses the entire shop.

A well, guarded by a moveable hand railing, opens into the basement and is so arranged that trucks can be backed into the basement from outside the building and loaded or unloaded by the crane. Through a trap in the floor, armatures or heavy machines can be lowered to the shop, also in the basement, and placed directly upon the lathes to be repaired.

The switchboards, four in number, for arc, incandescent, railway and power circuits, are located near the west walls, and are built up of slabs of slate marbleized in imitation of Mexican onyx. Most of the instruments and fittings were furnished by the Westinghouse Electric and Manufacturing Company. All wires pass from the machines through the floor into the basement and thence to the switchboards. Leaving the latter at the top they run along the wall and turn into the wire tower, whence they pass up and out to



THE ELMIRA ILLUMINATING COMPANY'S NEW CENTRAL STATION.



MACHINE ROOM:—ELMIRA ILLUMINATING COMPANY.

the lines. Every wire is in plain sight and supported by porcelain tubes or cleats. In building the station a place was provided for every wire so that there is no confusion in finding a wire or circuit when wanted. All the wires in the tower are so arranged that a short circuit is impossible, but the tower can be flooded if necessary from a stand pipe by simply turning a valve. It is separated from the main building so that there is no danger to the machinery from water in the event of such an emergency.

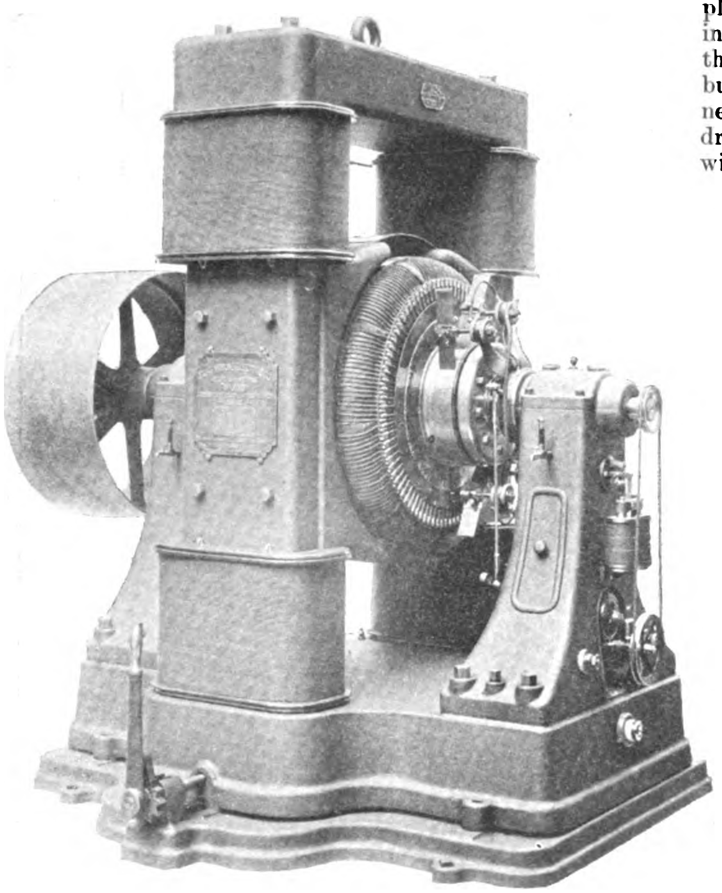
The type of boiler used is the Hammond improved Manning. Unlike the old Manning these boilers have double fire boxes, and the tubes are placed so that the boilers can be entered through a manhole in the shell, for inspection or for cleaning. At the same time the spreading of the tubes gives a double circulation, a larger water and steam space, and more surface for the steam to rise from. They have proved themselves far better even than was expected, are quick steamers, give absolutely dry steam, and afford very high economy. They carry a working pressure of 160 pounds. Three different ways of feeding are provided; a steam pump, a power pump and an injector, and all feed-water passes first through a Hoppes purifier; while a track from the coal sheds to the boiler room on a slight down grade provides an easy way of supplying fuel. Outside the boiler room and separated from the building is a brick-lined steel chimney 150 feet in height with a 6-foot flue erected by the Philadelphia Engineering Co. It is shown as the initial at the head of this article.

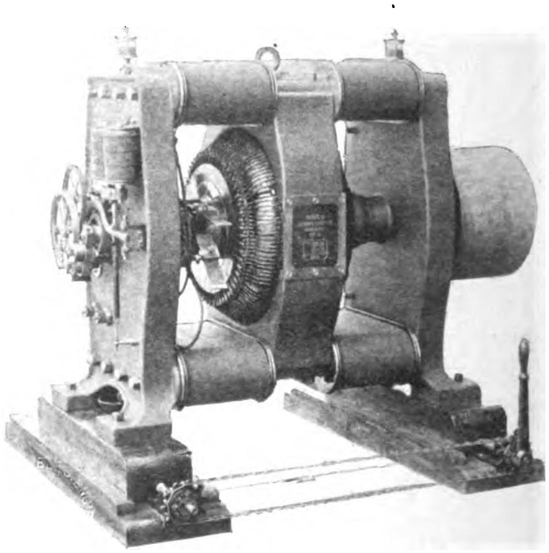
The water supply for the condensers and boilers is brought through a 14-inch pipe from two artesian wells at a distance of about a mile from the station, that provides an abundance of pure cold water at a constant temperature of 51 degrees. Arrangements have also been made so that water can be pumped, should it ever be necessary during repairs, and the pump for this purpose is also connected for use in case of fire.

At the south end of the building separated from the machine room by a fire wall are the store rooms and the station office. One room is provided for linemen where line material of all kinds is stored and cared for, another room is used for repairing, testing, and storing arc lamps; other rooms, for storing meters, house wiring material, shades, globes and supplies of all kinds, which are in charge of a a store keeper. The architectural work of the building is the work of Otis Dockstader, and is a good example of its style; not ornamented, but businesslike and substantial, and above all, well arranged with a view to the purposes for which it was built.

NEW ARC LIGHTING APPARATUS OF THE FORT WAYNE ELECTRIC CORPORATION.

Among progressive designers of arc lighting apparatus in this country there has been of late a marked tendency towards the production of dynamos of far higher voltage and far higher capacity or output than those that have heretofore been in use. They have recognized the fact that in these days of reduced rates for both city and commercial arcs, the small and relatively econonomical generating units of the past are at a disadvantage; while the disposition to drive arc lighting wires underground even in the smaller cities has compelled a resort to longer single circuits, in place of the many short ones more familiar to the art. The two reasons named have perhaps been most influential in bringing about the change, though others may be found in the advance of the art of dynamo design, the higher quality of insulation in line construction, and the disposition to employ larger direct driving engines in central stations. We illustrate this week a new dynamo, just placed upon the market, which has a peculiar and timely interest not only as illustrating the very latest advance in the direction of bigger dynamos for arc lighting circuits, but as being the first piece of apparatus introduced by the new Fort Wayne Electric Corporation, since its recent dramatic change of name and dissolution of partnership with the General Electric Co.

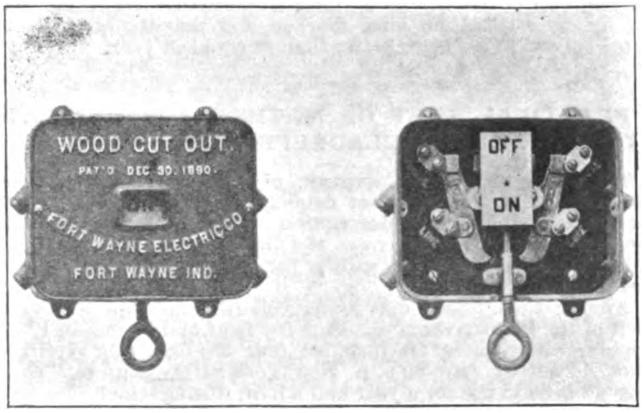


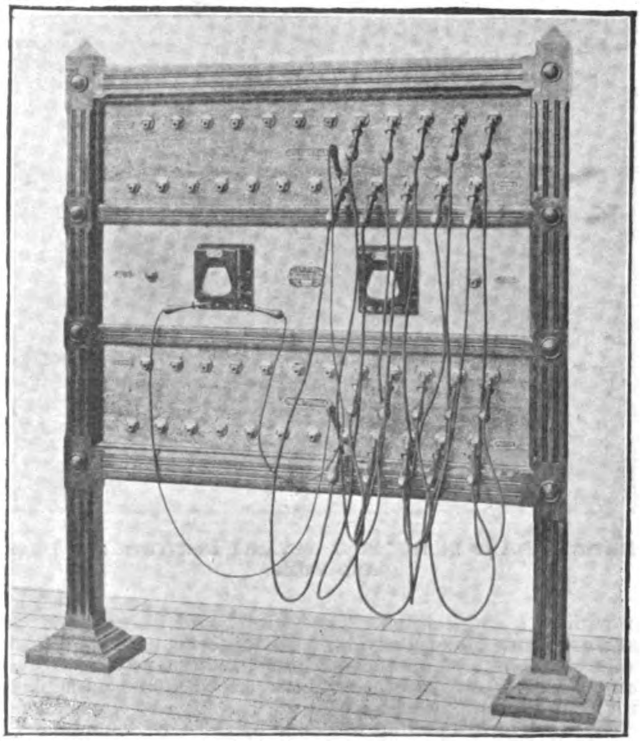


Figs. 1 and 2.—New Fort Wayne Wood Arc Dynamo, and the Old Style.

The largest arc machine heretofore designed by Mr. J. J. Wood and built by the old Fort Wayne Company, was a machine capable of generating current for 80-2,000 candle power lamps. Recognizing the demand for a larger unit than this, Mr. Wood, a veteran in this field, some time since started on the design of a machine of practically twice this capacity, and the result of his intelligent work is represented in the machine illustrated in Fig. 1. The relation which the new machine bears to the old type is best shown by comparing the two, which are here placed side by side, Fig. 2 representing the 80 lighter, both reduced to the same scale. The new machine is said to be the largest self-contained arc machine ever built. On a recent test it operated 153 full arc lamps on the 38-mile circuit of the local Fort Wayne electric light company, for a period of 18 hours, after having been previously operated for 30 hours. In other words, the machine ran continuously for 48 hours. The following data regarding the machine will prove of interest:

E. M. F. at terminals	7,050
Current in amperes	9.6
Revolutions per minute	500
Number of lamps in circuit	150
Average volts per lamp	47
Weight of armature complete	2,288
" " dynamo	14,600
" " " with sub-base	15,800
Temperature of field magnets after 10 hours' run	68° C.
Temperature of armature core after 10 hours' run	95° "
Temperature of wire	60° "
Temperature of room	27° "
Watts output at full load, speed 500 r. p. m.	67,680
Total watts generated	74,446
Commercial efficiency	90.91%

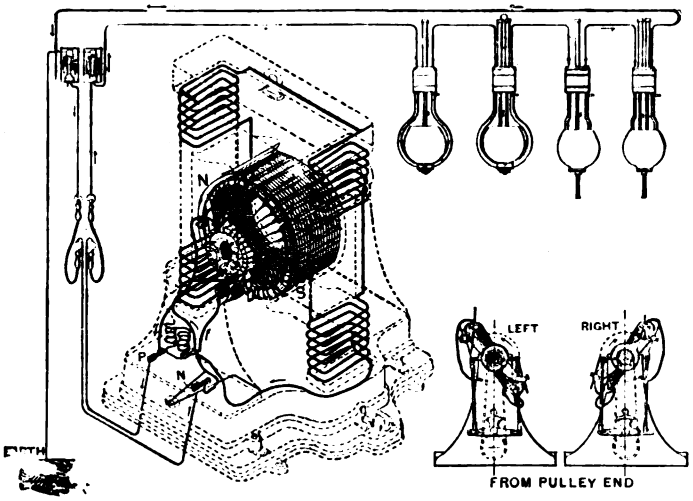


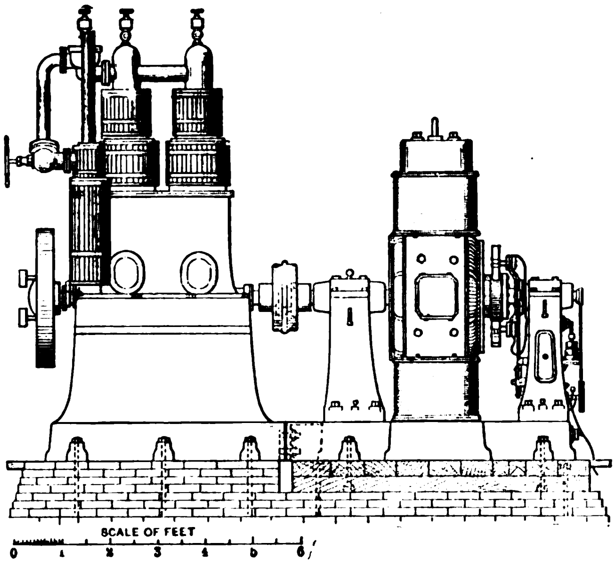


Figs. 5 and 6.—New Fort Wayne Cut-Out and Arc Switchboard.

During the test of the machine the potential at the terminals was measured by means of two Weston voltmeters, specially designed for the purpose.

It will be noted that in the new machine the field magnet frame has been placed in an upright position. The cores upon which the field coils are wound are massive wrought-iron forgings, joined by a heavy cast-iron yoke at the top and provided with cast-iron pole pieces. The entire regulating mechanism is placed within the pillow block and is operated by a small round belt from a pulley at the end of the armature shaft. The regulation of the machine is effected after the manner of the Wood system, now well known and long tried. Sparking is almost entirely avoided by varying the distance *i. e.* the number of commutator segments between the two positive and the two negative brushes. The regulation is such that fifty lamps and more can be switched in or out without fear of endangering the machine. It is, indeed, remarkable that an efficiency exceeding 90% should be secured in an arc machine, as it is in this.





Figs. 3 and 4.—Circuit of New Wood Machine: and Diagram of Direct Coupled Unit.

The circuits of the machine and its connections are shown in Fig. 3. From these it will be evident, as stated above, that the machine is entirely self-contained. The wires leading to the circuits are taken from the binding posts at the base of the machine and carried below the floor to the switchboard, thence through the lightning arresters and to the outside circuits. This leaves the dynamo room entirely free from the wires which usually connect with such a machine from overhead; and thus gives the whole a substantial and neat appearance.

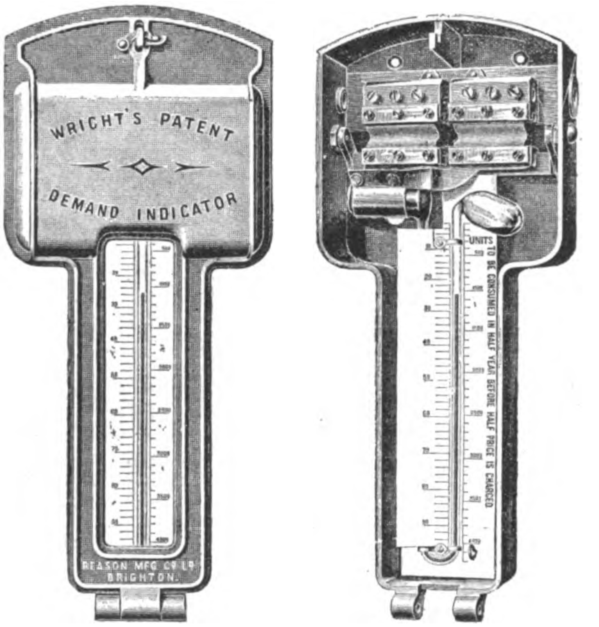
The engraving, Fig. 4, shows the new Wood machine coupled direct to a Willans high-speed engine. This combination was got up to meet the specifications of the Detroit municipal electric light plant.

Among the new auxiliary apparatus manufactured by the Fort Wayne Company is the arc switchboard shown in Fig. 5. The plug sockets are mounted on marble bases, the line terminals above and the dynamo terminals on the lower board, with the voltmeter and ammeter and ground connections on the central panel. This board embodies the ingenious devices of Mr. Wood, by which a circuit can be changed from one machine to the other without causing a break in the circuit.

Fig. 6 shows the Wood cut-out for arc work. It is so clearly illustrated here as to require no explanation.

AN ELECTRIC CURRENT "DEMAND INDICATOR."

In its description of the Brighton, Eng., Electric Supply Station the London *Electrician* describes what is termed a "demand indicator," the object of which is to furnish a correct means of ascertaining the actual call each consumer makes upon the generating plant of the central station.



FIGS. 1 AND 2.—WRIGHT'S DEMAND INDICATOR.

In order to understand the duty of this instrument it is necessary to describe the system of charging adopted by the Brighton Corporation, which is as follows: 7d. per unit (1,000 watt hours) is charged until the quantity consumed amounts to a use of the average maximum demand for 365 hours in half a year, which equals two hours per day, and all current consumed in excess of this quantity is charged at 3½d. per unit. The average maximum demand of each consumer is directly shown by the demand indicator being read once a month and the mean being taken as the consumer's actual demand. The Brighton instruments are calibrated to show directly the number of units to be consumed in the half-year before half price is charged instead of in amperes, as, at the Brighton voltage, each ampere used for two hours per day equals 42 units in the half-year. On this system the consumer is allowed a rebate directly his own load factor exceeds 8⅓ per cent.

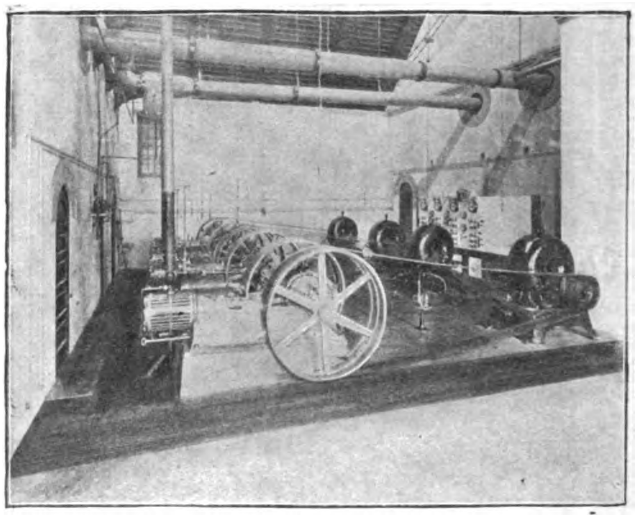
But the consumer is allowed to have a blaze of light occasionally, without fear of being betrayed by the faithful indicator. In order to prevent any single special demand for electricity raising the number of full-price units, the consumer may, in the event of his intending to burn a number of lamps in excess of his usual maximum on any such occasion not exceeding once in each month, give 24 hours' notice, in writing, of such intention to the Corporation, and they will thereupon short circuit the consumer's "demand-indicator" from registering the demand on the occasion so notified.

Two views of this indicator are seen in the accompanying engravings; Fig. 1 shows the front exterior of the instrument, as it is placed in the consumer's house, and Fig. 2 shows the interior arrangements of the latest pattern. The current passes through a heating resistance coil which surrounds a sealed glass bulb, connected to which is a U-shaped tube filled with liquid, with a trap bulb at its further end. On current passing through this heating coil the air in this bulb is expanded and forces part of the liquid in the tube to overflow into the trap bulb, where it remains until reset. When the current is cuto ff, the air in the heating bulb naturally contracts, and the liquid in the tube therefore recedes, leaving a part proportional to the maximum current that has passed in the trap bulb, and displaying in the tube against the scale a shortened column of liquid similar to a thermometer. It will be seen that the lower the column of black liquid in the glass stem, the greater must be the number of full-price units consumed before the 50 per cent. rebate commences. The heat developed is, of course, proportional to the square of the current, but, owing to the cushioning due to the air in the receiver bulb, the volume of liquid spilled is practically proportional to the first power of the current. Great care is taken to calibrate every indicator, but the scales are almost exactly, if not quite uniform. The instruments are reset very easily, all that is necessary being to tilt the interior part, which is hinged for the purpose, until the liquid in the trap bulb flows back and refills the tube. The loss of pressure does not exceed half a volt even in the smallest instruments, and is quite inappreciable in the larger ones. The influence of this demand indicator upon the habits of the consumer is most salutary. Instead of burning a great many lamps at a time for short periods, he is induced to burn a normal number of lamps for long periods; thereby unconsciously flattening the station load diagram and filling out the work of the plant over an extended period. The engineer of the Brighton station reports that the influence of this indicator has been most marked, and that the station load factor is now 15 per cent. better than during last year.

A PRACTICAL TEST OF MATHER APPARATUS IN PHILADELPHIA.

The Mather Electric Company, of Manchester, Conn., has issued a small and convenient catalogue from the press of Bartlett & Co., giving a short description of the improved, ring type dynamo with the dimensions of the different sizes manufactured by the company, together with a partial list of plants now in operation.

Among these plants may be especially mentioned the equipment of the Pennsylvania Institute for Deaf and Dumb, in Philadelphia, where there are installed four 550-light ring type dynamos, driven by four 60 h. p. New York Safety engines. These have all been in use for a year and a half, during which they have run without a single hitch. The switchboard is furnished with Mather instruments exclusively, with the exception of a Weston station voltmeter. A special building has been provided for the plant, which is now operating between 2,000 and 3,000 lights, with room for more when needed.



MATHER PLANT IN THE PENNSYLVANIA INSTITUTE FOR DEAF AND DUMB.

The work of installation was done by Chas. S. Solomon & Co., of Philadelphia.

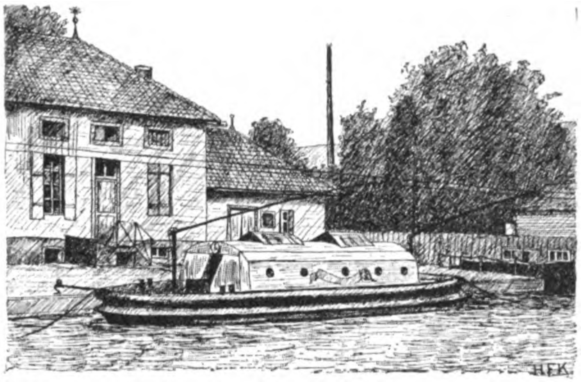
CENTRAL ASIAN TELEGRAPHS.

A young Chinese engineer Woo Hown Yung, who was educated at the Hopkins Grammar School, New Haven, Conn., has erected, it is said, a telegraph line crossing about 3,000 miles of Central Asia, starting from Tientsin. Branch lines are now in course of erection to connect with the Russian network.

ELECTRIC TRANSPORTATION DEPARTMENT.

AN ELECTRICAL CANAL BOAT IN FRANCE.

In The Electrical Engineer of April 11, 1894, an account was given of the use of an electrical canal boat on the Canal de Bourgogne, France. The boat is now illustrated. Water power is utilized for the generation of the current, which, by means of a double overhead trolley line is carried to an electric motor on the boat. This motor drives a drum over whose teeth pass the links of a submerged chain, by hauling upon which the boat makes its advance slowly. The chain is shown in the drawing, at the head and stern of the boat. In this instance the motor takes the place of the ordinary steam engine, in driving the haulage drum. In the de Bovet system, which has been noted in these columns, the drum is made magnetic in order to obtain greater hauling effort.

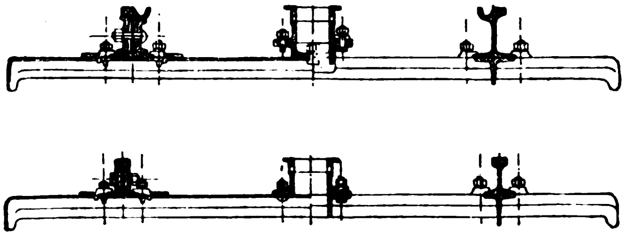


Trolley Canal Boat on the Canal de Bourgogne.

It may be noted that in the installation upon the Canal de Bourgogne, the generating plant charges accumulators during the night, the current from which is utilized during the day. The use of the motor is said to be found economical, while less attendance is necessary, and the absence of the heat, etc., encountered in the use of steam, makes the newer method far preferable. Part of the current from the generating plant is also used to light a tunnel through which the barges pass.

THE BARMEN ELECTRIC RACK RAILWAY.

The cities of Barmen and Elberfeld occupy a prominent position as German industrial centres; and they also have claims to natural charms almost equally famous in North Germany. Surrounded by forest-clad hills and highlands, they possess in these admirable breathing places the means of recreation for the city workers. For a long period however, the difficult access to the neighboring hills has proved a great obstacle to any extensive enjoyment of natural beauties; and wishes have continually been expressed for some method of transit by means of which there might be obtained sufficient accommodation for the heavy passenger traffic from Barmen to its southern suburbs, where there are magnificent parks and forest land, giving splendid views of the Wupper valley.

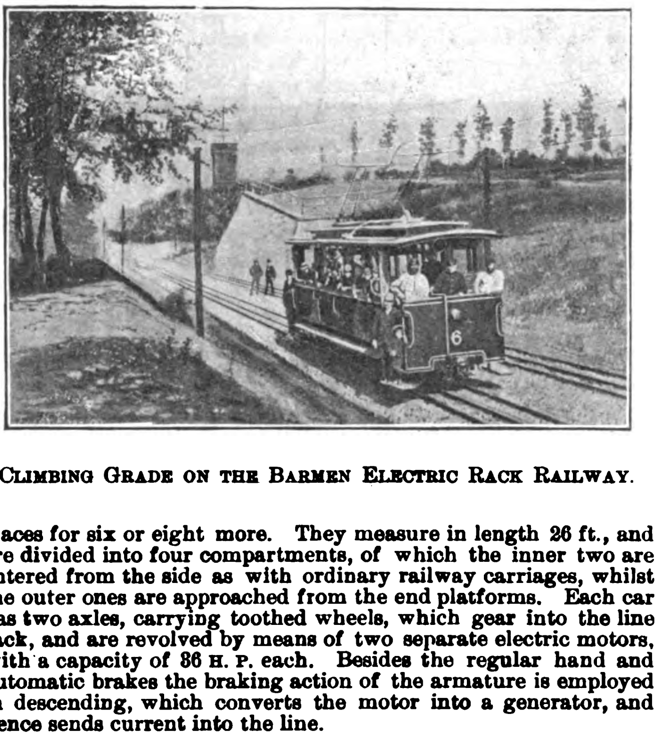

Sections of Track on Barmen Electric Rack Railway.

The plans submitted by Siemens & Halske for the operation of a rack railroad by means of electricity were, after due consideration, accepted by the Barmen Mountain Railway Co.

The line begins in the centre of the town in a large terminal station building which fronts upon the Clepestrasse. The total length of rack line is as near as possible one mile, in which distance it rises about 550 ft. The mean grade is therefore, in round numbers, 1 in 10, the steepest grade on the line being, 1 in 5.4 and 1 in 7.2. The sharpest curve, where the line crosses into the Luisenstrasse, has a radius of 500 ft. Besides the two termini there are also two intermediate stations or stopping-places—one on the Lichtenplatzerstrasse, and another near the Kohlenstrasse. The line is double track throughout, and is of metre gauge. Between each pair of rails is fixed a rack rail of the Riggenbach pattern, with teeth about 3½ inches long, pitched 3 inches apart. Each section of rack rail is about 10 ft. long. The adhesion rails are in general of the ordinary flat-bottomed type, though Phœnix girder rails (with grooves as used on street tramways) are employed for the sections along or across the streets. Both rack and adhesion rails are fastened to iron cross sleepers, spaced 40 inches apart. To prevent the rails—both adhesion and rack—from slipping downwards, they are firmly secured for their entire length to footplates bolted to the sleepers; whilst at intervals of 50 or 60 yards two adjacent sleepers are firmly anchored to strong concrete foundations sunk deep into the earth. The adhesion rails average 30 ft. in length.

At the terminal stations there are provided cross transfer tables, worked by electric motors, which move the cars—as they arrive—from one line to the other; all shunting is thereby avoided and a great amount of time and trouble saved, as the tables operate automically.

The rolling stock is designed solely for passenger traffic, each car having accommodation for 28 persons seated, with standing places for six or eight more. They measure in length 26 ft., and are divided into four compartments, of which the inner two are entered from the side as with ordinary railway carriages, whilst the outer ones are approached from the end platforms. Each car has two axles, carrying toothed wheels, which gear into the line rack, and are revolved by means of two separate electric motors, with a capacity of 36 H. P. each. Besides the regular hand and automatic brakes the braking action of the armature is employed in descending, which converts the motor into a generator, and hence sends current into the line.



Climbing Grade on the Barmen Electric Rack Railway.

The cars are lighted, of course, by means of incandescent lamps, fed with current from the main conductor. The latter is placed overhead, along the centre line of each pair of rails; it is of solid drawn copper, and hangs at a height of about 16 ft. above the ground level from insulators, on cross wires, which span the track at regular intervals of 100 ft. or so. Along the city streets these span wires are stretched across from insulators on the top of ornamental steel tubular poles; but outside the town, and along the line where fenced in, wooden poles are employed for the purpose. Traveling contact between the conductor wires and the motors on the cars is maintained by means of two oblong metal frames, the top sides of which bear against the under side of the conductor. The frames themselves are supported by tubular uprights hinged to the car roof, and so arranged with strong spiral springs that the frames at the top come, as stated, into contact with the conductor wire. The return circuit is completed through the rails to the supply station, strong copper bonds of large section being employed to connect the rail ends together electrically.

The supply station where the necessary electric current is generated for the line is situated in the Barmen town terminus, underneath the platforms and rails. Two horizontal compound condensing steam engines, running at 165 revolutions, are employed for driving the generators, each engine indicating 250 h. p. They are coupled direct to two ring dynamos with interior field magnet system, generating current at a potential of 500 volts. The total capacity of the station is such as to allow of erecting two more generating sets and two more boilers, similar to those now in use; and these will probably soon be required, for the station not only supplies current for the mountain railway but also for private purposes in the town for electric lighting, small motors, etc. Besides this, it will provide electric energy for a complete system of street tramways in the town.—*The Railway World.*

THE PATTON SYSTEM OF STREET CAR PROPULSION.

Among the many attempts that are being made from time to time to introduce a system of street car propulsion intended to supersede the overhead trolley construction, the Patton system is one of the latest claimants for recognition. It consists essentially of a combination of gas engine, electric generator, storage battery and motor, all carried on one car. The arrangement is shown diagrammatically in the accompanying figure.

The chief point of merit claimed consists in the employment of a storage battery so arranged as to be capable of being charged continually by the generator, which from the intermittent character of the load can be of considerably less capacity than would be required were the power of the engine to be applied to the car axle direct. In the diagram, E represents a vertical gas engine, coupled direct to the shunt-wound dynamo G; a battery of accumulators is shown at B, and the motor is represented at M. The controller is shown at C, and R is the starting rheostat.

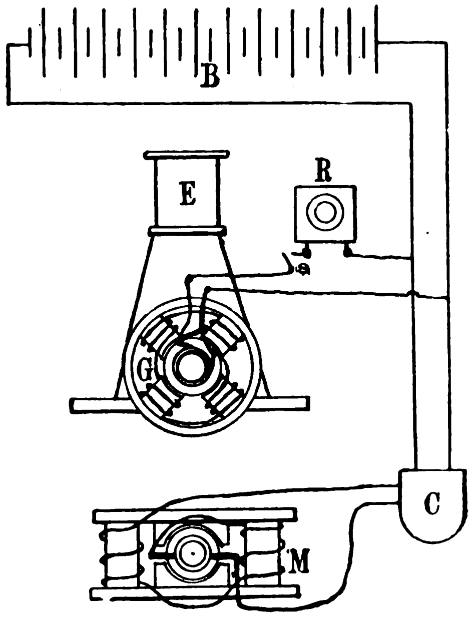


Diagram of Circuit in Patton System.

A car equipped with a combination of this kind has been in operation on the Calumet Electric Railway lines at 67th street in Chicago for several weeks and is reported as giving general satisfaction. The operating expense is said to be about one-half that of running a trolley car of the same capacity.

BROOKLYN TROLLEYS TO CARRY THE MAIL.

The Atlantic Avenue Railroad Company has made a contract with Postmaster Sullivan in Brooklyn for carrying the mails from the mail office to the Union station at Fifth Avenue and Thirty-sixth street. From this point the mail will be transferred to a special closed trolley car, painted white, and marked "U. S. Mail," for distribution along the line of the road from the station to Coney Island. The company is also considering the proposition of putting mail boxes on all the trolley cars for the convenience of the passengers.

ESTIMATED COST OF SUBSTITUTING ELECTRICITY FOR CABLE ON THE BROOKLYN BRIDGE.

The trustees of the Brooklyn and New York Bridge now have under consideration the use of electricity for lighting and propelling the Bridge cars. The Bridge itself has been lighted by electricity for many years. The subjoined figures were submitted, it is said, by the General Electric Co. in 1892, but the items of apparatus would now be much lower than then :—

Estimate of cost and operating expenses of electrical equipment for the New York and Brooklyn Bridge, dispensing with both cable and steam locomotives, and utilizing present steam plant :

First, on basis of present car mileage of 1,269,597 car miles per year. Power required, twelve trains maximum service, five shifting, seven running, of which four are ascending and three descending—five shifting will require a maximum of 1,000 H. P., four ascending will require a maximum of 1,000, three descending will require no horse-power. Total running plant required 2,000 H. P. Reserve 1,000 H. P.

Horse-power hours per round trip: Each train takes an average of 200 I. H. P. for nine minutes during each round trip, or 30 I. H. P. hours ; 420 trips per day will require I. H. P. hours per day, 12,600, or per year, 4,616,700.

Power Plant : 2,000 I. H. P. active, 1,000 reserve ; cost of dynamos at $25 per I. H. P. installed, $7,500 ; cost of line, $6,000 ; cost of motors for fifteen trains, at $10,000 per train, $150,000 ; total investment, $231,000.

Operating expenses of motive power : Power plant—fuel, per 4,616,700 I. H. P. hours at four pounds per I. H. P. hour, 8,244 tons at $2.50 per ton, $20,610 ; water, $2,610 ; oil and waste, $3,610.

Wages : One superintendent and electrician, $2,500 ; three engineers, $3,600; three assistants, $3,000; four firemen, $3,000; interest, 5 per cent. on $75,000, $3,750; maintenance, 4 per cent. on $75,000, $3,000; total, $44,680.

Line Expenses : Interest 5 per cent. on $6,000, $300; maintenance, 4 per cent. on $6,000, $240; total, $540.

Motor Expenses : Interest, 5 per cent. on $150,000, $7,500; maintenance, 8 per cent. on $150,000, $12,000; total, $19,500.

Recapitulation : Expense power plant, $44,680; expense on line, $540; expense on motors, $19,500; total motive power expense, $64,720.

For double the present car mileage the operating expenses would be approximately double and would be close to $120,000 annually. In case of such extension a 1,000 H. P. unit should be added to the plant and placed at tide-water. It could then be made compound condensing and made to do the greater part of the work with considerable saving of fuel. The electric system could be operated to Tillary street without any additional expense for motive power.

Estimate of substituting electric motors for the locomotive shifters on the New York and Brooklyn Bridge, on basis of present car mileage and separate power plant :

Power Plant: Real estate, $5 per H. P.; building, $10 per H. P.; boilers and furnaces, $17 per H. P.; piping, pumps, etc., $3 per H. P.; engines, condensers and foundations, $25 per H. P.; generators and switchboard, $20 per H. P. Total, $80 per H. P.

Cost of 1,000 H. P., $80,000; cost of line, $4,000; cost of motors, controllers, equipment, etc., at $10,000 per train, fifteen trains, $150,000. Total investment, $224,000.

Operating Expense—Power Plant : Fuel per year, three pounds of coal for each horse-power hour, $1,717; water, $171; oil and waste, $171.

Wages : One superintendent and electrician, $2,000; two engineers, $2,400; two assistants, $3,000; two firemen, 1,400 H. P. hours per day, $1,500. Total, $9,959.

Interest, 5 per cent. on $80,000, $4,000; maintenance, 4 per cent. on $80,000, $3,200. Total, $17,159.

Operating expenses line, $369; operating expenses motors, $19,500. Total, $19,869. Total motive power expenses of shifting with present car mileage, $37,019; per day, $191.

Investment for double the present traffic, $466,000; total motive power expense on basis of double the present car mileage, $68,150.

Cable Expenses : Coal, $16,148; water, $1,101; repairs, $4,248; wages, $21,702; supplies, $9,718. Total, $52,917.

Grand total cost of motor-power for switch engines and cables, $113,825.

The following was the cost of operating the bridge cars for twelve months ending Dec. 1, 1891:

Number of passengers carried, 39,766,043; number car miles run, 615,562 trips, at $2\frac{1}{16}$ miles per trip, 1,269,597.

Fuel, $14.690; water, $554; repairs, $8,276; wages, $31,968; supplies, $5,420; cost of locomotives, 109,528 miles run at 55.6 cents per mile, $60,908.

Subtract from $113,825, which represented the cost of operating the bridge in 1891, the estimate of the General Electric Company, which is $64,720, the apparent annual saving in favor of the use of electricity would be $49,105.

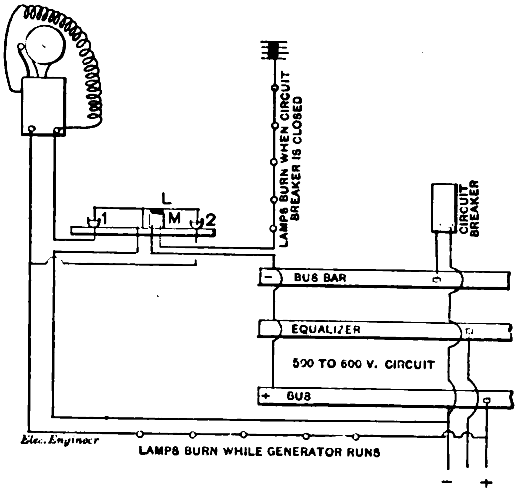
TROLLEY CURRENTS AND RAILROAD SIGNALS.

English engineers have taken warning by experience with electrolysis on this side of the water and the Board of Trade has laid down various requirements for the control of the circuits of electric street railways. In the course of the discussion before the Board of Trade during the drawing of the regulations, the question arose whether the wandering earth current from an electric railway might not reach the track circuit of a block signal system on a steam railway line, set the signal at safety when it should be at danger, and thereby cause a serious accident. In ordinary signaling practice, the semaphore drops by gravity to the danger position and is raised by an electric current to safety. When it is remembered that the wandering earth current of electric railways is sufficiently powerful to work electric bells and telegraph instruments, and has even, in some cases, we believe, been made use of for incandescent lighting, the possibility that, under proper conditions, such a current might cause a semaphore to show a wrong indication would seem to be by no means remote. It is true that no instance of this sort has thus far been made public ; but it is to be remembered that electric railways are still a novelty and little used outside of the United States, and that only a fair beginning has been made in the equipment of this country's railways with block signals. Besides this, many things occur in railway service which are long in being made public, and because no instance of the turning of a semaphore in the manner described is on record, it does not, therefore, follow that none have occurred or may not occur in future.—*Engineering News.*

A TELL-TALE FOR CIRCUIT BREAKERS.

BY E. M. HIGHLANDS.

I HAVE on two different occasions found in central stations operating both railway and lighting circuits with only one man who attends both to engines and dynamos, that when the whole plant is in operation the circuit breaker often blows out without the engineer hearing it and consequently often remains open quite a while. The superintendents of these plants generally try to cut expenses and object to installing any apparatus that is not absolutely necessary, and on these occasions for an outlay of $8 to $10 I have been able to place the following alarm on the circuit which rings a 7" gong while the circuit breaker is open and the instant it is closed immediately ceases to ring, and it does this without the use of batteries or any attention whatever. I think the diagram herewith will be almost self-explanatory:



TELL-TALE FOR CIRCUIT BREAKERS.

Two circuits are required, one on each side of the circuit breaker, one to ring the bell and the other to operate the switch. The operation is as follows : The magnet M attracts a pivoted lever L, which completes a circuit through a cup of mercury 2, which cuts the bell out. When the circuit breaker opens, the magnet releases the lever L which makes contact through cup 1 and consequently rings the bell which has a 7 inch gong. A shunt of 100 ft. of No. 30 wire from the negative binding post to the vibrator post prevents sparking at the bell contacts. I think this scheme is in use in several Iowa stations, having been seen and approved of by visiting electricians.

ELECTRIC LOCOMOTIVES FOR THE BERNESE OBERLAND.

It is stated that the Bernese Oberland Railway Co. is contemplating the substitution of electric traction for steam, the scheme comprising 200 h. p. locomotives with 10 trains on the line simultaneously, water power being used as the source.

ELECTRIC HEATING FROM RAILWAY POWER STATIONS.

BY A. H. PERKINS.

IN THE ELECTRICAL ENGINEER for May 30th I find another contribution to the subject of electric heating. This subject has received considerable attention of late, but I have not seen mentioned a scheme which appears to have more of the elements of success in it than most writers have found in the problem.

In small electric railway plants the variation in load is extreme, and the prime mover must be of sufficient size to furnish the maximum output ; so that it often happens that the prime mover cannot be of the right size to produce even the best average result, while this best average result is one of low efficiency under such varying loads. To obtain some data on the effect of electric railway loads on engine economy, I made, recently, some computations. The subject of engine economy at different loads has been worked up very carefully by Prof. R. C. Carpenter, and very useful and interesting results are given by him in the Proceedings, Am. Inst. Elec. Engrs. of May, 1893. These results embody such a large number of tests that they should be reliable.

In making the above-mentioned computations I took a power curve of 25 minutes duration, traced by an automatic recorder, and divided it into 50 convenient parts with respect to time. The average power for each part was then multiplied by the length of the time, and this product by the steam consumption at that rate of output obtained from Prof. Carpenter's diagrams. In this manner the total steam consumption for the generation of the whole power was obtained and the efficiency under the changing load reached.

I found that under the conditions treated, the steam consumption was increased by 17 per cent. above that which would have been used had the engine worked at its best load at all times. The maximums and minimums in a power curve are not of long duration on a small road. It would therefore be possible to fill up the low places in the power curve, and use the extra energy for heating by turning the extra power at low points of the power curve into heating mains. Details of an automatic device for this are simple and will suggest themselves. An extra circuit is, however, required.

Suppose now that we have a small plant with such an arrangement. Neglect the effect of any benefits to be derived from increased efficiency under the steadier loads, and suppose coal to be consumed in direct proportion to the number of H. P. hours of power used. The only items of cost increased are those for coal, oil, waste and water. Where slack costing $1.50 at furnace door is used, the consumption will be about 5 lbs. per E. H. P. hour and the cost for the items named above will be 0.5 cent per E. H. P. hour. 24 E. H. P. hours are about equivalent to 46 lbs. of coal burned with an efficiency of 10 per cent. Hence with coal at $5.50 per ton delivered, the cost with coal is $\frac{5.50 \times 46}{2,000} = \$0.126$. With the above cost per E. H. P. hour, the same test from electricity costs' with 100 per cent. efficiency $24 \times 0.005 = \$0.120$. Interest on extra circuit and apparatus may bring this up to the cost given for coal.

Attendance for the coal plant has yet to be considered. With a furnace burning 7 tons in the six cold months, attendance figures up at $0.10 for burning 46 lbs. When the work is cooking or office warming, to which such a system is best adapted, the margin of profit to be made by the sale of this energy would seem to be greater than is furnished by most lines of business ; for not only is 10 per cent. a high figure for the efficiency of coal directly burned for these purposes but the factors of handiness and cleanliness are representable in cash.

MAILS BY ELECTRIC CAR IN MONTREAL.

MR. G. C. CUNNINGHAM, managing director of the Street Railway Company says that it is intended to build special mail cars, each containing a staff of clerks who would sort the mail on their way to and from the various city suburbs. He has seen the postmaster in regard to the scheme and that gentleman has approved of it. It is understood that the Government is willing to adopt the new method of carrying the mails from one part of the city to the other.

BOSTON OVERHEAD WIRES ORDERED DOWN.

THE WEST END STREET RAILWAY has been formally notified of an order passed by the Board of Aldermen on April 16, to remove all the feed and return wires of its overhead trolley system in the crowded parts of the city and place them underground. The road is given until November 15 next to complete the work. The Western Union Telegraph Company, the New England Telegraph and Telephone Company, and the Boston Electric Light Company have also been ordered to place their wires underground in certain parts of the city.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

GEO. M. PHELPS, President. F. R. COLVIN, Treas. and Business Manager.

Edited by
T. COMMERFORD MARTIN AND JOSEPH WETZLER.
Associate Editor: GEORGE B. MULDAUR.

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Western Editor and Manager C. KAMMEYER, 1439 Monadnock Building, Chicago, Ill.

New York Representative, 203 Broadway, } W. F. HAMES.
Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada, - - - - - - - - -	per annum,	$3.00
Four or more Copies, in Clubs (each) - - - - - -	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies, - - - - - - - - - - - - - -		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

VOL. XVII. NEW YORK, JUNE 20. 1894. No. 320.

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CART ROADS *vs.* TROLLEY ROADS.

A SHORT time ago an investigation was made into the condition of the country roads in Ohio by a State Commission, with the special object of ascertaining whether it would not be possible to adopt the trolley on some of the roads, as a means of handling farm freight and produce. It appeared, that in Ohio, there are 80,000 miles of common road, but of these only 10,500 miles are improved, 7,000 being in macadam and 3,500 in gravel. In two thirds of the counties, only common dirt roads exist, and these are useless for wheeled traffic nearly one-quarter of the year. Such conditions are pretty near those of savagery, and yet to bring the roads up to a proper pitch of smoothness and permanence, would take the sum of about $400,000,000. Even in the suburbs and outskirts of the larger cities, where bad roads must inflict a terrible tax on market gardeners, the rural highways were shown recently, by photographs, to be in a disgraceful state. The report pointed out, that the power necessary to move a ton of freight over steel rails is one-eighth that required on a macadam road, one-eighteenth that on a graveled road, and but one-twenty-fifth of that on an ordinary dirt road. The report advocated the use of light electric trolley roads, therefore, and said that "the profitable use of steel rails and the application of inanimate power can only be limited by the convenience or inconvenience of terminal facilities;" while it made a special reference to the transport in this way of farm food products whose value lies largely in their reaching the market in a crisp, sweet and fresh state for immediate distribution.

In view of the reported fact that a good stone road costs as much as a trolley road per mile to build, and in many places quite as much, if not more, to maintain, we need not wonder that the investigation in Ohio has attracted attention in Pennsylvania and New Jersey, where there are large farming districts badly supplied with roads, surrounding large centres of population and consumption. More than one trolley road in this country is already hauling farm produce, but the experiment on the large scale contemplated by the Ohio report remains to be made. We trust something will soon be done in this direction, and can only hope that there will be conservative work, and no craze or boom. We know of work already laid out for two roads across farming country, one in New Jersey and one in Ohio, both over 30 miles in length; while there are many parts, such as the New England States, where the rural trolley systems answer fairly to the service proposed by the Ohio Commission. But in these cases, passenger traffic is a considerable factor in the estimates or income, whereas the new idea is to open up rural regions in which the mere travel must necessarily be small at low rates and where the handling of farm produce must yield the main revenue. It looks as though a lighter form of trolley road than any yet built might be required, and that even the telpher system might here find its opportunity. It would seem also that in many parts of the country, canal transportation, in view of its great cheapness, would enjoy renewed attention, especially as electricity as a motive power is now readily available in place of the towpath mule.

IS IT AN OVERCROWDED PROFESSION ?

An electrical engineer in good standing and of excellent attainments and experience, was engaged recently by a manufacturing company to design for it a new street railway motor. He did so, with details as to windings, weights, dimensions, efficiency, and other matters. He was paid $25, and the purchasers were disappointed to learn that the price did not include a full set of tracings and blue prints to work from in the shop. These, however, which would take, perhaps, a couple of weeks to get up, they were offered for another $100.

When we remember how much the designing of street railway motors has done for the fame and fortune of early workers in this field, it would seem, indeed, that the profession has fallen upon evil times when a new motor can be designed by an engineer for the wage that is paid in a single week to an ordinary clerk or mechanic. But it is as well to face the facts, and the incident is worth the attention of the bands of young men now pouring every year out of universities and colleges ready to redesign and remake all the apparatus already in use.

What the art wants, in truth, is not new designs so much as men able to get the best results out of the old; not new designs in an industriously cultivated field but pioneer work in branches of the art that have not yet been attacked. There are plenty of good street railway motors, but there are very few roads where the employment of a staff of competent engineers would not be attended with large savings. The central lighting stations are full of admirable dynamos, but the dividends earned by careful management and technical ability are scanty and wide apart.

There is a slight consolation in the fact that even in these dull and dreary days, at least one concern is willing to spend the enormous sum of twenty-five good dollars in obtaining designs of a new motor to build. There is the further consolation that the cheaper motors, dynamos, lamps and switches are, the larger the demand is likely to be, and the greater the consumption of current and supplies.

BACTERIA IN TELEPHONES.

An interesting full-page article appeared in the New York *Herald* of June 10 on the attractive subject of bacteria in telephone transmitter mouthpieces. That danger of disease from contagion may lurk in the supposedly innocent telephone is said by our contemporary to be the "amazing discovery" of Dr. W. T. Scheele, of this city. It strikes us that the discovery is not amazing, and it is quite certain that it is not original with the Herr Doctor. One is made rather uncomfortable, of course, by contemplating these olla podrida pictures, enlarged from microscopic slides, of dust, hair, wool, fragments of profanity, débris of the noonday lunch, whiskey fumes and other useless bric-a-brac; but if the Herr Doctor will only take the trouble to show up samples of New York sidewalk, elevated railroad matting, or the free ice-water cups, he can easily make everybody much more unhappy. In the case of the telephone transmitter, if danger really lurk in its bare and highly polished funnel, it is not extremely difficult to keep one's distance, talk louder or use a more sensitive circuit ; but, alas, the other things, as well as the national habit of indefatigable expectoration, are too much with us. If the Herr Doctor really wants a new subject of the sensational order, we recommend to his notice fan motors as breeders of pleuro-pneumonia. This is a theory which can be supported without fear of contradiction, whereas the theory of deadly telephones is offset by counter theories. It is declared by modern science that all human breath carries a poison with it, and that one of the marked effects of this poison if inhaled in a crowded place, is an increase of cerebral activity, though not of a high order, but the contrary, as in Congresses and Parliaments. Now, as a matter of fact and observation, the act of sitting down to the mouthpiece of a telephone is usually accompanied by an arrest of cerebral activity, so much so that the person trying to talk at either end rattles off some loose, snippy remarks and gets through the job quickly. When one sits down to the mouthpiece of a phonograph, also, it is very hard to think of anything to say into it. Hence it is evident that in some way the mouthpiece and its diaphragm neutralize or render harmless, on the homeopathic plan, the "pulmonary toxine ;" and, with the new telephone tariff system in force, of so much per message, it is plain at once that the telephone is really a cure for diseases due to the breath, including loquacity.

EQUALIZING STATION LOADS.

Economy in central stations has long since been shown to be dependent largely on the character of the load carried, and to equalize the engine load as much as possible is the chief aim of the careful manager. Various methods have been suggested for this purpose all depending hitherto on the internal method of operating the station; but it would seem that the aid of the consumer can also be called in here to good advantage, judging from the results recently attained at Brighton, England. By means of a "demand indicator" whose operation may be likened to that of a maximum thermometer, the Brighton station is enabled to obtain a fairly accurate knowledge of the customer's habits and at the same time keep a check upon him. By grading the charges, the consumer, as is shown by actual results, refrains from habitually throwing on heavy loads for short periods but maintains a more uniform consumption. It may appear strange at first sight to fine a consumer for using a heavy current, but closer consideration will show that in the long run the method inures to the benefit of both consumer and station.

ESTABLISHING ELECTRICAL UNITS BY LAW.

A bill of Mr. Charles W. Stone of Pennsylvania has passed through the House of Representatives, to define and establish the units of electrical measure. It gives legal recognition to the eight units of electrical measure adopted by the International Electrical Congress which met in Chicago last autumn. These electrical units are the familiar units of resistance, current and E. M. F., known as the ohm, the ampere and the volt respectively. To these are added the unity of quantity, designated as the Coulomb; the unit of capacity called the Farad; the unit of work, the Joule; the unit of power, the Watt, and the unit of induction, called the Henry.

MISCELLANEOUS.

THE NEW YORK CONSTITUTIONAL CONVENTION AND PUBLIC SERVICE CORPORATIONS.

BY ALLEN R. FOOTE.

An opportunity of high public importance is presented by the meeting of a convention for the revision of the Constitution of the State of New York, to embody in the new Constitution the results of experience in the organization and control of public service corporations. I doubt if any subject of greater and more far-reaching importance will be urged upon the attention of the Convention.

In the past, public service corporations have been incorporated either by special Act or under general laws designed for the incorporation of stock companies for manufacturing and other purposes. This method has permitted an era of private corporations organized to supply public needs, in whose behalf the right of eminent domain has frequently been exercised and for the proper conduct of whose business special uses of public thoroughfares have been granted. The control of such corporations solely in the interest of the public welfare has not been attempted. It has been the policy of politicians to frame the laws and ordinances of control for such corporations so as to make and keep them a source of private revenue for the party in power. From the blackmail levied by bills, ordinances and orders introduced into State Legislatures and Municipal Councils, corporations have found no means of escape. On the other hand, the abuse of corporations has induced many abuses by corporations, in the efforts of their managers to protect the interests intrusted to them by their shareholders, and as a result the public mind has become deeply prejudiced against all forms of corporate undertakings. The trend of events within the past few years clearly shows a well defined tendency to react from securing a public service by contract with private corporations to the reverse extreme of supplying the service from a plant owned and operated by the Municipality—a political corporation. In this case as in the former, it is still the policy of politicians to keep the supplying of public needs as far as possible a source of revenue for political purposes, if not for private gain. In the disbursements of large sums of tax-payers' money for the construction of plants to be followed by the political patronage and contributions to campaign funds contingent upon the continuous purchase of supplies and the employment of an ever-increasing number of persons, politicians see a way to make themselves good for the loss of revenue by blackmail they will experience by transferring such undertakings from private to public—or political—ownership.

It is not strange that under these circumstances honest-minded people have been led to conclude that there is no cure for the evils of improperly controlled public service corporations, owned and operated by private capital, except in improperly controlled political corporations, owned and operated by capital collected by the arbitrary authority of taxation.

In the public interest and in the interest of all capital now invested in such enterprises, I believe a successful move can now be made to place in the Constitution of the State of New York provisions that will permit a final settlement of this question on the middle line between the two extremes that I have attempted clearly to indicate in my discussion of the economic principles involved in "The Law of Incorporated Companies Operating Under Municipal Franchises." Of this discussion Edward A. Ross, Ph.D., Associate Professor of Political Economy and Finance in Cornell University, wrote in the *Progressive Age*, March 1, 1893, as follows:

> "By means, then, of State regulation securing publicity and fixing prices to consumers, would Mr. Foote solve the problem of municipal industrial corporations. Something might be said in criticism of minor points of his scheme, but justice compels us to say that no plan has yet been proposed that offers so satisfactory a solution of the conflicting interests, of investors and the consuming public. Doubtless the present war been gas companies and city councils will continue for a long time. Doubtless the plan of State control will be hotly rejected by both parties; but we believe that a candid examination of Mr. Foote's plan will convince one that fifty years from now the relations of private municipal companies to the patrons and to the State will be something like that which Mr. Foote recommends."

Managers of public service corporations and investors in their stocks and bonds should lose no time in winning to their support the large body of well meaning people who are seeking to advance good municipal government by provisions in the new State Constitution, for such provisions as well make a settlement of these questions that will be fair to the public and just to corporations.

INSURANCE IN HARTFORD, CONN.

An insurance journal records the fact that in the city of Hartford, Conn., the Board of Fire Underwriters have recently employed an expert to make a thorough inspection, with the result of finding 57 stores and offices in the business part of the city, including two large hotels, utterly unsafe from defects in the insulation of the electric light wiring.

A COMPARISON BETWEEN WELSBACHS AND ARCS.

In the course of a paper read before the Western Gas Association, Mr. Highlands, of Clinton, Ia., said:—

"As some of you probably know we also supply gas to Lyons, a city of some 7,000 inhabitants, immediately adjoining Clinton. Lyons has a municipal electric light plant that also supplies domestic lights. This plant has been established some ten years, while the gas mains were only run three years ago. At the time we extended the gas mains there, nearly all the stores and shops were using the electric light. We did not make any effort to displace the electric light, but instead, concluded we would see what a fair competition between gas at $1.75 per thousand and arc lights at $5.50 each per month would result in. For the first year or so, we did not do a great deal of business with the stores. A customer would use the gas through the summer and then put back the electric lights in the winter when the evenings were long. In the summer of 1893, we sent fifty Welsbach burners up there to see what they would do. We equipped one large jewelry store with them at our expense and then waited for results. And they have been surprising, indeed; for to-day there is not one store in the city using electric lights, the Welsbach burners having entirely displaced them; but at the same time it has cut down our sales of gas and I do not know but that we had better let a few of the electric lights come back, if we can only get rid of the Welsbach burners. The burners are all that is claimed for them, and give our customers unqualified satisfaction; but the confounded things won't let any gas through them. This same jewelry store that was formerly using two arc lights, only used three thousand feet of gas in December. After our experiment with them at Lyons, we would prefer furnishing electric lights, rather than Welsbach burners, in Clinton.

TAUSSIG'S ELECTRIC SMELTING PROCESS.

In the U. S. *Consular Reports*, Mr. Frank H. Mason, consul-general at Frankfort, Germany, describes a process invented by Mr. Edward Taussig, of Bohrenfeld, for the smelting and casting of metals by electrical heat, under the influence of rarefied air. The operation consists in fusing ores or metals in a closed furnace or chamber, the hearth of which is connected with molds into which the fused metal flows by gravitation, and is cast into any desired form, and in both of which (molds and furnace) the air has been rarefied as far as practicable through exhaustion by air pumps or other mechanical means.

The apparatus includes a long, air-tight smelting channel or chamber, the hearth of which inclines to a central orifice, through which the fused metal passes into the molds. This chamber is filled with the metal to be smelted, and heat is generated by passing an adequate current of electricity through the mass without the use of any kind of fuel, or the employment of carbon electrodes. In this latter respect, the inventor of this process claims that it is entirely original and distinct from all other electrical smelting systems now in use in this country.

From the testimony of experts who have examined this process in operation, it appears that a degree of heat sufficient to smelt pig iron in fifteen minutes can be generated and maintained without unduly heating the other parts of the circuit, and this is equally true of the smelting of easily fused metals like lead and zinc, and of Siemens-Martin steel of Swedish origin, which is known to be one of the most refractory of all the useful metals. The entire absence of coke, coal or carbon electrodes secures to the fused metal nearly absolute purity, and the continued exhaustion of air and the gases generated by smelting increases the fluidity of the molten material and wholly prevents oxidation and blistering and produces castings of a dense, smooth quality, which have shown, under elaborate tests made by unimpeachable authority, the highest mechanical qualities of which cast iron is capable. It is estimated that with a plant equipped with a motive force of 500 to 600 horse power and supplied with good, ordinary 48 per cent. ore, the cost of producing a ton of pig iron—allowing $2.40 per ton as the price of the ore—would not exceed $9.65, and this, in the opinion of the inventor, could be easily reduced to $8 per ton if a motive power of 1,000 horse power were employed.

MAGNETIZATION OF IRON AT HIGH FREQUENCIES.

At a recent meeting of the Kaiserliche Akademie der Wissenschaften of Vienna, Prof. Klemencic read a paper on the magnetization of iron and nickel wires by rapid electrical oscillations. An abstract of this is given in *Nature*. From the amount of heat developed in a wire of a magnetic material traversed by electrical oscillations, the author calculates, by means of the formula given by Lord Rayleigh and Stefen, the value of μ (the permeability). The heat developed in the wire under observation was determined by means of a thermoelectric couple, and was compared with the heat developed in a non-magnetic wire under similar circumstances. The following are some of the values obtained for μ: Soft iron, 118; steel wire, soft 106, hard 115; Bessemer steel, soft 77, hard 74; nickel 27. These values agree very well with those obtained by Lord Rayleigh and Bauer for very feeble magnetizing forces. The results obtained by these observers show that for certain values of the magnetizing force the permeability is constant, and that it afterwards rapidly increases. Now the results obtained by the author show that over the range he is employing μ has a constant value. This fact may be explained either by supposing that the magnetizing forces employed are so small that we are dealing with that part of the curve where μ is constant, or that, although the magnetizing forces are much greater than those to which the former supposition limits us, the magnetization is unable to follow the rapid changes in the magnetizing force, so that the magnetization never reaches that part of the curve where μ is variable and has very much greater values. A rough estimation has shown that, at least on the surface of the wire and at the commencement of the oscillations, the magnetising force exceeds more than a hundredfold the maximum limit within which μ is constant. Thus, in these experiments there must exist a time lag in the magnetisation which must not be confused with the hysteresis. It would also appear that Bauer and Lord Rayleigh's results which refer to longitudinal magnetization, also apply to circular magnetization.

BEHAVIOR OF CERTAIN BODIES IN PRESENCE OF ELECTRO-MAGNETIC OSCILLATIONS.

A NOTE on the above subject by Prof. G. M. Minchin, was recently read before the London Physical Society. Referring to the employment of impulsion cells, metallic films, etc., for detecting the nodes of electro-magnetic vibrations, the author says that so far the physical states of such bodies are too variable to be of service. Metallic surfaces formed by embedding fine metallic powders in films of gelatine, shellac, or sealing wax, are, as described in a previous communication to the Society, found to act as insulators, but become conducting when subjected to strong electro-magnetic disturbances. After a current has once passed through such a film, its resistance is changed by very feeble impulses, whereas previously it failed to respond to strong ones. On breaking contact by removing the electrode from the surface, the film loses its conductivity, the time necessary to do this depending on the hardness of the matrix. The resistance of a film containing tin powder, measured between the rounded tips of two platinum wires 1 centimetre apart, varied under the electro-magnetic impulses from 8 to 180 ohms. In conclusion the author points out that with films and tubes the whole phenomenon relates to change of resistance, whereas impulsion cells may have currents from external sources passing through them whilst in either the sensitive or insensitive state.

SOME WESTERN MUNICIPAL ELECTRIC LIGHTING EXPERIENCE.

AT the recent meeting of the Western Gas Association, Mr. I. C. Copley said:—My own city is the first in the country to go into municipal lighting on its own account; they have an arc lighting plant on which they have spent between sixty-five and seventy thousand dollars; they run a little over two hundred arc lights in conjunction with the water works which is owned also by the city; the amount of coal used for each—water works and electric lighting plant—is estimated; engineers' and firemen's salaries are also estimated; and we have a magnificent system of water works that scarcely pays interest on its bonds. The electric light, however, is being furnished, according to the estimate of the Board of Public Works, at very cheap rates; they estimated them at fifty-six dollars apiece last year; but that does not include depreciation or interest on the plant. They are running not to exceed two hundred lights at one time; about one hundred and seventy-six of them is the average throughout the year. You can easily add the depreciation and see that it brings the cost of the lights to nearly eighty dollars a year apiece. Now there are any number of cities in our neighborhood that are getting their lights from eighty to one hundred dollars a year apiece from a private corporation. And it seems to me that we are very much more secure, we feel at any rate very much more secure, and we also feel that we are making out of it all that we possibly could make out of it by taking a contract at such figures as we would have to take it in order to get it, and content ourselves with letting the city attend to its own lighting and we sell the commercial light.

IMITATING THE EARTH'S MAGNETISM WITH WYLDE'S MAGNETARIUM.

AT a recent meeting of the Royal Society a remarkable electrical novelty was exhibited in the shape of Henry Wylde's magnetarium, a globe, which was so endowed with magnetic properties that a magnetic needle swung at any point on the surface showed the same dip and declination as it would on the surface of the earth. The curious effect is brought about by a skillful distribution of electric currents, one set flowing through insulated coils on the under surface of the thin shell on the visible globe and another set through similar coils on the outside of a slightly smaller sphere, arranged inside the first and caused to rotate with its equator in the plane of the ecliptic of the outer globe.

A COMPETITIVE TELEPHONE SERVICE FOR BROOKLYN.

THE Brooklyn Board of Aldermen recently took up Mayor Schieren's veto of the resolution giving a franchise to the New York and Eastern Telegraph and Telephone Company, which has promised cheap telephones to Brooklyn. The ground of the veto was that the company had not indicated when it proposed to begin operations.

President Edwin M. Willard of the telephone company, made a direct appeal to the Aldermen to override the veto. In his letter he said that the company proposed to begin business at once. He continued:

"There has been a mighty effort made in Philadelphia to throw off the yoke of this galling Bell telephone monopoly. Chicago, Buffalo, Albany, San Francisco and New York city itself have seen this monster struggle to prevent competition, and all that the parent company in Boston, with its $50,000,000, and its hundred offspring auxiliary companies with another $100,000,000 capital, can do to strangle competition will be done.

"The fact that an American invention like the telephone is enjoyed in London by a very much larger percentage of the population for $25 per annum; in Berlin communication can be had by each subscriber with over 20,000 other subscribers anywhere within a radius of twenty miles for an annual payment of less than $40, must be an unanswerable argument to show the outrageous conditions here."

The Aldermen voted, 18 to 6, to override the veto. Alderman Cohen, in arguing in favor of the Mayor's action, suggested an investigation to discover just how the thirteen necessary votes had been secured.

It is alleged that the new company has no serious intention of beginning business, but simply seeks to secure a franchise for speculative purposes.

ELECTRIC TANNING.

L. A. Groth, the inventor of the electrical tanning process, writes *Hides and Leather* from Orbe, Switzerland, that his system is in successful operation there in the sole leather tannery of Jules Rodd.

After the hides have been unhaired and fleshed in the usual manner they are worked slowly in a drum with soft water, then rinsed and placed in Groth's tanning vats. The hides are hung on a special frame work, which is given a reciprocating or rotary motion in the vats. After remaining in the liquid for from three to four and-a-half weeks, they are said to be completely tanned and are withdrawn, scoured, rinsed in clean water and dried. The total time required, from the day the green hides are placed in soak until the leather is brought into the warehouse, is from five to seven weeks. The tanning liquor used is preferably a mixture of oak wood extract and pine extract. The first liquor, being naturally weak, is strengthened four times during the tanning, so that its final strength is 20 degrees, according to the barkometer used. The electric current is applied during the tannage, according to the nature of the hides, condition of the tanning liquors and description of leather required.

Mr. Groth continues: "Extensive experiments have been carried on to ascertain whether it is better to keep the hides in motion or stationary in the tanning liquors. The result was in favor of motion. The cost of keeping liquors in circulation by constant pumping is somewhat heavy." He employs an apparatus by which the hides are given the reciprocating or rotating motion, but are also lifted up and down, whilst the liquors are kept constantly in circulation, without any pumping being required.

SPECIFIC INDUCTIVE CAPACITY OF SOLIDS UNDER EITHER SLOWLY OR RAPIDLY CHANGING FIELDS.

In the Johns Hopkins *University Circulars* Mr. Edwin F. Northrup has a preliminary note on an investigation entitled as above. The objects in view are, first, to perfect a method which will enable the specific inductive capacity of solids (for which substances the value of K departs most from the required relation) to be determined under fields of force varying either slowly or rapidly, as desired, and second, to employ the method for finding if the agreement with the theory is closer in the latter than it is in the former case. The author describes the apparatus employed and gives the results obtained with the first substance experimented with, namely, paraffin. For slow fields this material showed the value of K to equal 2.317; with rapidly oscillating fields, 2.252. The investigation will be continued.

TERMINATION OF THE BRUSH BALTIMORE CONTRACT.

MAYOR LATROBE, of Baltimore, has notified the Brush Electric Company that the city would terminate its existing contract for electric lights on July 1st. Proposals will soon be invited by advertisement for lighting the city in whole or in part with electric lights for a term of five years. The city authorities, if they see fit, can divide the contract.

LEGAL NOTES.

THE DECISION AGAINST POWDERED SILVER LEADING-IN WIRES.

EDISON ELECTRIC LIGHT COMPANY ET AL. *v.* BOSTON INCANDESCENT LAMP COMPANY ET AL.

CIRCUIT COURT OF THE UNITED STATES, DISTRICT OF MASSACHUSETTS—IN EQUITY —OPINION OF THE COURT, JUNE 11, 1894.

Colt, J. The second claim of the Edison incandescent lamp patent (No. 223,898) is for "the combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purposes set forth."

The defendants' lamp, constructed after the Pollard patent of November 1, 1892, contains all the elements enumerated in this claim, namely, a carbon filament, all-glass receiver from which the air is exhausted, and conductors passing through the glass. The only difference between the two lamps is that the defendants use a film of powdered silver for the conductors passing through the glass, in place of platinum wire which Edison points out in the specification of his patent as the material to be employed, and which is always found in the Edison lamp of commerce. In other respects the lamps are identical. While Edison uses platinum wire, he does not limit himself to this form of conductor in his claim. The language of the claim is "conductors passing through the glass," and therefore on its face the claim covers all kinds of material capable of carrying the electric current. If the claim had been limited to conductors of platinum wire, as the filament is limited to carbon, the case might be different.

The invention of Edison resides in the carbon filament; the other elements of the combination were old and subordinate, and represent, so to speak, only the environment of the filament. For this reason I do not think the Court should seek to restrict the plain meaning of the language of the claim. And there is another reason for giving the claim a broad construction. Edison made an important invention; he produced the first practical incandescent electric lamp; the patent is a pioneer in the sense of the patent law; it may be said that his invention created the art of incandescent electric lighting. Where a valuable invention has been made, the Court will uphold that which was really invented, and which comes within any fair interpretation of the patentee's claim. *Merrill* v. *Yeomans*, 94 U. S., 568, 573.

The argument of the defendants is that this claim of the Edison patent must be limited to the use of platinum wire as a conductor, or its known equivalent, and that powdered silver was not a known equivalent at the date of the Edison patent. Looking generally at the state of the electrical art, at the date of the Edison patent, and comparing platinum wire and powdered silver simply as elements apart from any specific combination or invention, it cannot be said that one was not a known equivalent of the other, because powdered metals, including silver, have been recognized since 1860 as conductors of electricity. In asserting that powdered silver was not a known equivalent of platinum wire, the defendants must mean that it was not a known substitute in the combination or invention of the Edison patent, or in the art of incandescent electric lighting, and I think the evidence proves this to be true; but in dealing with an invention which is broadly new, I am not prepared to accept the proposition that, in order to constitute infringement, an equivalent in a patented combination must always have been known at the date of the patent, or must have been such as would occur to a skilled mechanic exercising only ordinary mechanical skill.

While the language of the Supreme Court in *Gould* v. *Rees*, 15 Wall, 187, and other cases, seems to support the defendants' contention on this question, the later decisions by that Court are not reconcilable with the broad proposition that in all cases the substitution of an equivalent will avoid infringement provided it was not known at the date of the patent, using the word "known" in its ordinary sense. *Morley* v. *Lancaster*, 129 U. S., 263; *Clough* v. *Barker*, 106 U. S., 166; *Machine Co.* v. *Murphy*, 97 U., S. 120. In the Morley Case, Mr. Justice Blatchford, speaking for the Court, says:

> "A difference in the particular devices used to accomplish a particular result in such a machine would always enable a defendant to escape the charge of infringement, provided such devices were new with the defendant in such a machine, because, as no machine for accomplishing the result existed before that of the plaintiff, the particular devices alleged to avoid infringement could not have existed or been known in such a machine prior to the plaintiff's invention."

In that case the patent was for a machine for automatically sewing shank-buttons to a fabric, and it was the first machine to accomplish this result. In the defendant's machine, the feeding and sewing mechanisms were new, and had been patented, yet the Court held that it infringed the Morley patent. The feeding and sewing devices of the Lancaster machine in the art of automatically sewing shank-buttons to a fabric were as unknown at the date of the Morley patent as a conductor made of powdered silver at the date of the Edison patent in the art of incandescent electric lighting.

In dealing with a pioneer invention which creates a new art, it hardly seems logical or reasonable to say that, because in the progress of such art some new substance or device has been discovered which can act as a substitute for one of the elements of the patented invention, any one can appropriate the invention by the employment of such substitute. And further, if equivalency signifies equivalency in the particular combination or invention, it is difficult to point out in this class of cases what known equivalents existed at the date of the patent for the reason that the combination of elements in which the invention is embodied was first made known by the patentee. The doctrine of equivalents as applied to primary inventions rests upon a more satisfactory basis by the elimination of the qualification of age or time, and by holding those things to be equivalents which perform the same function in substantially the same way. The fundamental question is whether the alleged infringer makes use of the essence of the patented invention, not whether he has adopted a known equivalent or made a patentable improvement on the invention. The motion for preliminary injunction is granted.

GOVERNMENT SUIT TO ANNUL THE BERLINER PATENT.

Argument was begun in the United States Circuit Court, District of Massachusetts, before Judge Carpenter; in Boston, June 14, in the United States of America *vs.* American Bell Telephone Co. and Emile Berliner—the suit instituted by Attorney General Miller toward the close of the Harrison Administration—for the repeal of Berliner's patent (463,569) of November 17, 1891. Counsel for complainant are the Attorney General Hon. Richard Olney; the U. S. Attorney, Sherman Hoar, Esq.; Causten Brown, Esq.; and ex-Judge Robert S. Taylor. Counsel for defendant are Wm. G. Russell, Esq.; Chauncy Smith, Esq.; James J. Storrow, Esq.; Frederick P. Fish, Esq.; and W. W. Swan, Esq. The nature of the allegations upon which the annulment of the patent is sought have been made familiar to the public through the press at various times. [See THE ELECTRICAL ENGINEER, February 15 and 22 and March 1, 1893.]

Judge Taylor opened argument for complainant, occupying the entire sessions of the court Thursday and Friday. His address was mainly directed to establishing the proposition that both the Bell Company and the officials of the Patent Office had been derelict in their duty to the public in causing or permitting the period of fourteen years to elapse between the application for the Berliner patent and its issue in 1891; a period during which the telephone company—through its possession of the Bell patents, Edison and Blake patents, as well as some early issued Berliner patents—had enjoyed a monopoly of the same invention, virtually, as that of the patent in suit. The delay was certainly most extraordinary, and it was quite clear that the effect of it, should the patent be sustained, must necessarily be of enormous advantage to the Bell Company in prolonging their monopoly of commercial telephony. In view of the obvious interest of the defendants the extreme delay in issuing the patent was to be explained only on the ground that there was collusion between the Bell Company and the Patent Office officials, or that there was at least a tacit agreement between them. More than this, there was an express consent to this delay, upon which the patent officials acted, upon which the Bell Company expected them to act, and upon which it was known they would act. This changed the attitude of the Patent Office officials from what would be otherwise negligence into what was active fraud. It was a most significant and suggestive fact that two of the examiners of the Patent Office left the employ of the Government to enter that of the Bell Company. These men have since appeared on the witness stand on behalf of the company and testified to the anxiety shown by counsel for the Bell Company for haste in the granting of the patent. "And this," said Judge Taylor, "is the testimony relied on by the defendant to show that it was honestly active in trying to secure an early granting of a patent." Copious extracts were read from the decisions of the courts to show that it was the duty of the Patent Examiner promptly and without delay to have reported in the case, and either have granted or rejected the claim for a patent. While the application was pending the Patent Office officials were distinctly advised by these decisions what should be done, and that they did not do this showed conclusively that they did not wish to issue the patent, and the reason they did not wish to issue it was that the Bell Company did not want it, notwithstanding its apparent anxiety for an early granting of the patent.

In respect to the part of the Bell Telephone Company in the long delay of the Berliner application in the Patent Office, it was, counsel thought, a case, not uncommon in human affairs, where duty pointed in one direction, interest in the other,—a situation in which the law applied to men a more rigorous standard of judgment than in any other situation in life. In such cases the presumption of the law was, not that the party would do his duty against his interest. but that he would serve his interest first; and if the event had been to his advantage and to the disadvantage of the party to whom duty was due, the burden lay heavy upon him to show the integrity of his conduct by the clearest proof. It would hardly be claimed that no duty whatever toward the public rested upon the Bell Company in respect to the prosecution of the Berliner application; that the company was entitled to lay its plans and time its proceedings with a view only to the prolongation of its monopoly by the postponement of the issue of its patent. It was bound to take *some notice* of some rights of the public, and owed the public *some duty* in recognition of those rights. The foundation of that duty was to be sought in that fundamental principle of legal ethics, which is expressed in the maxim that every man is bound to enjoy his own in such manner as not to interfere with the like enjoyment of their own by others, and the measure of it was the degree of injury liable to follow the disregard of the duty.

TAXING TELEGRAPH POLES IN ALABAMA.

ANOTHER suit of national importance has been docketed in the Supreme Court of the United States. It is the case of the Postal Telegraph Company, plaintiff, in error, *vs.* the State of Alabama, and is an appeal from a decision of the United States Circuit Court for the middle district of Alabama, and involves the question of the right of the State to impose on the company a privilege tax of $500, together with a further sum of $1 for each mile of line which the company operates. The Postal company contends that the tax is a restraint on the use of the post roads of the United States and an infringement on the legislative domain of Congress.

A VAN CHOATE PRONUNCIAMENTO.

Mr. S. F. Van Choate, of Boston, has issued a notice to everybody in general and to some of the electrical companies in particular, that he controls by patent all multipolar motors and generators, as well as every electric street car now in use. Mr. Choate is too modest to live in Boston.

A COLUMBIA LAMP INJUNCTION VACATED.

The injunction granted the Edison Electric Light Company against the Columbia Electric Light Company to restrain the use of incandescent lamps, etc., alleged to contain infringements on the Edison patents, was vacated in the United States Circuit Court, Philadelphia, on June 12.

THE CHICAGO EDISON CO. has brought suits against local users of infringing incandescent lamps, including the Star Electric Light Co., the Empire Electric Light Co., the Chicago Incandescent Light Co., and the Coöperative Electric Light Co.

THOMSON-HOUSTON REGULATOR.—The arguments in Chicago before Judge Grosscup on the alleged infringement of the regulator by the Western Electric Co. have been closed. The depositions filed in the case make 50,000 words.

RIGHTS OF ELECTRIC ROADS DEFINED.—At Trenton on June 12th a decision by Chancellor McGill was filed important to electric railways in New Jersey, as it defines clearly their rights relative to the erection of poles on other people's property and on the sidewalks. The case before the court was that of the Camden, Gloucester and Woodbury Electric Railway Company and the West Jersey Railroad Company. The latter company secured a temporary injunction against the electric company restricting it from crossing the former's tracks and erecting poles on its land. The court dissolved the injunction and says that electric roads are but a modified form of the horse-car system, and have the same rights and are under no obligations to pay extra compensation for the erection of poles upon abutting properties. As to the matter of speed and danger, the municipalities have power of regulation. Sidewalks, he says, are part of the highway, subject to the public easement. The placing of an electric pole immediately within the curb on the sidewalk is not an additional burden upon the land for which compensation may be required.

GROFF TELEPHONE CO.

ARTICLES of incorporation have been issued at Springfield, Ill., to the Groff Telephone Company, the capital stock being fixed at $1,000,000. The incorporators and stockholders are Lucian C. Pottiger and Calvin Reem, of Pennsylvania, and J. F. Tabor, William Bussell and W. F. Bigelow, of this city, all of the stock except $500 being subscribed by Lucian C. Pottiger. It is not the purpose of the company to establish any manufactory here, but to confine its operations to the sale of the Groff telephone and the management of exchanges in small towns.

NEW YORK ELECTRIC CLUB.—If sufficient subscriptions at $5 a head can be secured, the club will have a commemoration dinner on Thursday, June 21st, at 8 P. M. at the Imperial Hotel.

LETTERS TO THE EDITOR.

COMBINED ADVANTAGES OF BUS AND SELF-EXCITING METHODS.

ANY scheme, however ingenious, has no apology for its existence if it does not accomplish the end sought. Mr. Van Nuis' method of combining the advantages of both bus and self-exciting methods on analysis does not permit the bus exciting of a dynamo on starting up, without introducing the danger of a high potential discharge, and if Mr. Van Nuis will take the trouble to investigate he will find that the station managers that adhere to bus-exciting methods claim that the principal advantage of this method is that of being able to bring a dynamo up to proper potential to throw in on the bus as soon as the engine is up to speed. This also is the principal point claimed for bus-exciting methods in my paper, read before the National Convention Washington meeting. It is evident that Mr. Van Nuis's combined method falls short of the object sought.

Mr. Potter's method, illustrated in the issue of THE ELECTRICAL ENGINEER of June 13th, is certainly a practical solution of exciting compound wound dynamos. With this method applied to compound machines all the advantages of separate bus exciting can be obtained.

I cannot see clearly how Mr. Van Nuis still claims that he has single pole apparatus on his board, when it is evident that the potential of the bus exists between two adjacent field switch terminals after his equalizer switch has been thrown.

ALBERT B. HERRICK.

JUNE 15, 1894.

WOVEN WIRE BRUSH PATENTS.

REFERRING to a communication from Alexander P. Trotter, dated London, May 25, 1894, and published in THE ELECTRICAL ENGINEER of June 13th concerning "Woven Wire Brushes," I beg to call attention to the fact that if anyone interested in the matter therein referred to concerning the broad U. S. Patents on Wire Gauze Brushes will take the pains to examine the Patent Office Record of patent to Paget, No. 427,327, granted August 4, 1891, it will be ascertained that he, Paget, invented and used wire gauze commutator brushes as early as July 4, 1884, thereby antedating the British Patent referred to by more than three months.

C. J. KINTNER.

NEW YORK CITY, June 14, 1894.

INSPECTING THE NEW POSTAL TELEGRAPH BUILDING.

The following is a memorandum of the invitations that have been issued for the inspection of the new Postal Telegraph Building:—

Monday, June 18th.—Telegraph & Telephone Cos., Electrical Mfg. Cos., New York Daily Papers, Press Association, Electrical Papers and Magnetic Club.

Tuesday, June 19th.—New York Electrical Society.

Thursday, June 21st.—Resident members of the American Institute of Electrical Engineers, American Street Railway Assn., Association Edison Illuminating Co.'s, National Electric Light Assn.

Friday, June 22nd.—Department of Electricity, Brooklyn Institute, Department Electrical Engineering, Columbia College.

Tuesday, June 26th.—Commercial Travelers Club.

Wednesday, June 27th.—Will be reserved for the personal friends of the employés of the Postal and Commercial Cable Co. and the tenants of the building.

THE LEWIS ELECTRIC CO.

THIS company organized to exploit the Lewis electric car lighting system recently described in our columns has passed into the control of a syndicate in which Messrs. Drexel, Morgan & Co., are largely interested. The offices of the company have been removed to No. 80 Broadway. A car equipped on the Lewis system has been in operation on the Brooklyn Bridge for some time past, giving much satisfaction and another will shortly be equipped. Mr. G. W. Moslin has been elected president of the company, with Messrs. E. H. Johnson, E. West, Jr., I. N. Lewis and H. E. Fanshawe as directors.

THE GRAY TELAUTOGRAPH.

The Gray telautograph exchange in Lexington, Ky., of which brief mention was made in these pages some time since, is giving perfect satisfaction and, we understand, is commercially successful. This was the company's first experiment in a public telautograph exchange, as progress has been made continuously while the instrument has been reduced to still greater simplicity and perfection. Another shipment of instruments is being prepared for Syracuse, N. Y., where an exchange is about to organize, and a demand for them is being created in all parts of the country and in fact in all parts of the world, including China.

INVENTORS' RECORD.

CLASSIFIED DIGEST OF U. S. ELECTRICAL PATENTS ISSUED JUNE 12, 1894.

Alarms and Signals :—

Police Signal Telegraph System, C. A. Rolfe, Chicago, Ill., 521,183. Filed Oct. 22. 1892.

Specially adapted for fire alarms and intended to secure the accuracy of signals against the carelessness or ignorance of persons operating the boxes.

Burglar Alarm, C. R. Hoopes, Ogontz, Pa., 521,239. Filed Apl. 5, 1894.

An attachment for chain bolts.

Batteries:—

Thermo-Electric Battery, E. W. Jungner, Skara, Sweden, 521,168. Filed Mch. 9, 1894.

A chain battery adapted especially for fire alarms.

Electric Battery, F. Dubero and P. Mohrdieck, San Francisco, Cal., 521,260. Filed Jan. 15, 1894.

A sea-water battery, adapted for the renewal of parts without interrupting the action of the battery.

Clocks:—

Electric Clock Winding Mechanism, A. E. Vidal and G. Hervieu, London, Eng., 521,396. Filed Sept. 30, 1892.

An automatic system.

Distribution :—

System of Electrical Distribution, T. J. Fay, New York, 521,436. Filed Feb. 15. 1894.

Claim 1 follows:

In a multiple series system of distribution, the combination of a main generating station, two main conductors leading therefrom, an intermediate or compensating conductor between the groups or sets of translating devices, two generators connected in series with each other and normally tending to augment the supply of current to the mains, but so connected as to supply extra current to either group of translating devices which requires it in order to establish a balance between the two groups, and an electric motor driving both generators and supplied with current from the mains.

Lamps and Appurtenances :—

Incandescent Lamp Socket, L. R. Peck, St. Johns, Mich., 521,322. Filed Feb. 23, 1894.

Electric Arc Light for Magic Lanterns, C. Beseler, Jersey City, N. J., 521,362. Filed Mch. 16, 1894.

Arranged especially for the convenience of the operator in accurately adjusting the light relatively to the condenser of the magic lantern.

Duplex Electric Arc Lamp, G. F. Edens & J. B. Brewer, Xenia, Ohio, 521,434. Filed Mch. 31. 1894.

Relates to the trip-mechanism.

Measurement :—

Apparatus for Measuring and Recording Electric Currents, W. Thomson (Baron Kelvin), Glasgow, Scotland, 521,391. Filed Feb. 8, 1893.

A meter. Includes a fixed solenoid carrying a scale, a movable magnet carrying an indicator, a yielding support for holding the magnet normally in elevation and position to be attracted by the solenoid; also a registering device.

Miscellaneous :—

Core Attracting Solenoid, W. R. Michl, Wetter-on-the-Ruhr, Germany, 521,269. Filed Apl. 26. 1892.

Designed to render the action of the solenoid on a moving core uniform throughout the excursion of the latter. The number of convolutions of the conductor varies in consecutive sectional portions of the solenoid from one end to the middle and then again to the other end.

Railways and Appliances :—

Contact Trolley, R. W. Hawkesworth, East Orange, N. J., 521,163. Filed Mch. 15, 1894.

A two-pole trolley.

Bond for Electric Conductors, J. Herr, Philadelphia, Pa., 521,238. Filed May 11, 1894.

Especially designed for connecting a copper wire with a railway rail.

Trolley Wire Finder, T. E. Gressel, Indianapolis, Ind., 521,311. Filed Oct. 28. 1893.

Has directing bars or guides adapted to be elevated or withdrawn.

Conduit Supply System for Electric Railways, H. Alexander, New York, 521,326. Filed Jan. 9, 1894.

A conduit system employing a supply conductor, a sectional working conductor and electromagnetic devices for operating contacts.

Track Circuit, L. F. Johnson, Poughkeepsie, N. Y., 521,412. Filed Apl. 7, 1894.

For railway signaling.

Automatic Electric Signal Lamp, J. R. Farmer, St. Louis, Mo., 521,435. Filed Apl. 9, 1894.

A "right of way" signal for the junctions of electric railways.

Switches and Cut-Outs :—

Automatic Electromagnetic Cut-Out, L. T. Stanley, Brooklyn, N. Y., 521,423. Filed July 18, 1893.

A fuse cut-out.

Telegraphs :—

Printing Telegraph, O. L. Kleber, Pittsburg, Pa., 521,170. Filed April 18, 1893.

Transmits Morse signals and translates them into alphabetical letters and numerical characters, printing the latter.

Telephones and Apparatus :—

Magneto Telephone, A. Stromberg and A. Carlson, Chicago, Ill., 521,188. Filed Mch. 9, 1894.

A combined magneto telephone and magneto call box.

Electric Telephone, W. L. Richards, Malden, Mass., 521,220. Filed Dec. 14, 1893.

A transmitter of the class employing a mass of finely divided carbon; the granular carbon is contained in a block of slate, which also contains a fixed electrode and a vibratory electrode.

Telephone Switch, J. B. Smith, Manchester, N. H., 521,274. Filed Apl. 27, 1894.

A positive device independent of springs or weights, operated by suspending and removing the hand telephone.

Busy Test for Multiple Switchboards, J. A. Wotton, Atlanta, Ga., 521,303. Filed Apl. 20, 1894.

Telephone Transmitter, J. B. Smith, Manchester, N. H., 521,325. Filed Apl. 27, 1894.

A variable resistance transmitter especially intended for long distance work. Employs a cup containing finely divided conducting material, a multiple electrode made in sections, the alternate insulated layers of which are connected together, the cup being attached to the diaphragm.

Telephone Call Recorder, W. F. Smith, San Francisco, Cal., 521,422. Filed May 5, 1893.

Employs a printing mechanism at the central station adapted to be operated by subscribers, and intended to substitute a printed record for the ordinary verbal call.

PERSONAL.

MR. NIKOLA TESLA had the degree of LL.D. conferred upon him by Columbia College at the commencement exercises on June 13th. It will be remembered that it was at Columbia College, in 1891, before the American Institute of Electrical Engineers, that Mr. Tesla delivered the first of his brilliant series of lectures on his remarkable experiments with currents of high potential and high frequency.

MARRIAGES.

SARGENT—POOR.

AT the Cathedral Rectory, in Boston, on Monday, June 11, by Rev. Robert Neagle, George Nichols Sargent, of Melrose, Mass., junior member of the firm of Almon & Sargent, electrical engineers and contractors of Boston and New York, to Miss Alice Adelaide Proctor Poor, daughter of John A. Poor, Esq., of Albany, N. Y.

MULDAUR—SOUTHMAYD.

AT noon on June 14, in Christ Episcopal Church, Elizabeth, N. J., Miss Caroline Theodore Southmayd, daughter of John A. Southmayd, a retired New York merchant, was married to George Barton Muldaur. A reception followed at the home of the bride's parents. The groom is a son of the late Lieut. Muldaur, United States Navy, and is the associate editor of THE ELECTRICAL ENGINEER.

HENRY—SCRIVENER.

At St. Agnes Chapel, New York City, Dr. Bradley, officiating, Mr. Ira W. Henry was married to Miss Frances Scrivener, at noon, on the 6th of June, a large gathering of electrical and naval friends being present. Mr. Henry is the electrician and expert of the Bishop Gutta Percha Co. Capt. W. Wolcott Marks was his best man. The happy couple started on a trip to New Orleans and other Southern cities. Many handsome wedding presents were received.

SOCIETY AND CLUB NOTES.

THIRD DINNER OF THE "ELECTRIC POTENTIALS," BOSTON.

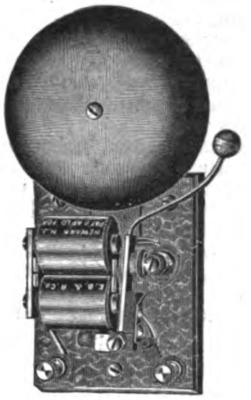
THE third dinner of the Electric Potentials was held at Young's Hotel, Boston, on Wednesday evening the thirteenth inst., President C. W. Holtzer, presiding, when Mr. I. H. Farnham delivered a most interesting and instructive address on the "Electrolysis of Pipes and Cables," illustrated by about fifty stereopticon views. There was a large attendance of the members, and fifteen applications for membership from well-known electrical engineers of Boston were presented and acted upon. The association is now an assured success and in the fall when the quarterly dinners will be resumed it is anticipated that the membership will be very largely increased, and that papers on subjects interesting to the electrical profession will be presented. Mr. Farnham's address based on his recent Institute paper, was greatly enjoyed by all, as it was given without notes and in an easy intelligible manner, which brought conviction to the minds of all his hearers.

Afterwards an informal discussion took place as to the methods of conducting the affairs of the Electric Potentials, and it was heartily recommended to continue the dinners, have interesting papers on each occasion, and in every way to make the Society as pleasant socially and instructive scientifically, as lay in the power of the Committee. Every member was cordially invited to work in conjunction with the committee, and any suggestions for meetings or entertainments will be gladly received, and get careful consideration. This is the last dinner for the season, and a most enjoyable evening was spent. It is to be hoped that early in the fall when the meetings resume, even more interest will be developed. All connected in any way with the electrical profession are eligible for membership, and the small initiation fee and annual dues put it within the reach of everyone.

Trade Notes and Novelties

AND MECHANICAL DEPARTMENT.

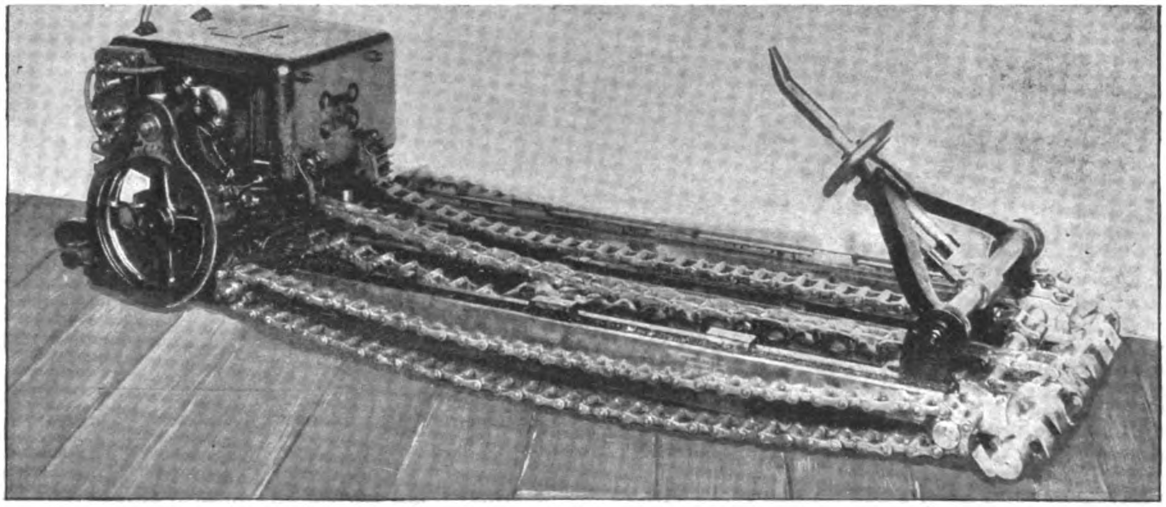
110-VOLT BELL OF THE ELECTRIC BELL AND RESISTANCE CO.



EVERYBODY must have noticed the tendency of late years to dispense, if possible, with primary batteries and to use the regular 110-volt, or other high volt, circuits in hotels, dwellings, offices, etc., and it will not be a matter of surprise to them, therefore, to find that the Electric Bell and Resistance Co., of 46 Lawrence street, Newark, N. J., are now making a bell, herewith illustrated, to go on circuits of from 50 to 500 volts, either direct or alternating, without external resistance. The novel features in these bells consist in winding a new high resistance conductor on the outside of the magnet coils and so connecting it that there is no inductive spark at the armature contacts. As the bells are wired up like ordinary lamps, and have cut-outs in circuit, the number of wires used in a building are diminished and the fire risk is lessened, especially as the bells will ring in the case of a cross with another circuit or a ground. The bells are mounted on bases of marbleized slate and present a very handsome, trim appearance. They are made in sizes of from 2½ to 12 inches, in vibrating and single shape forms, and much larger sizes can also be had. The company are also the manufacturers of high resistance coils for any purpose where the carrying capacity does not exceed 1.5 amperes.

NEW GENERAL ELECTRIC COAL CUTTER.

We illustrate here a new electric coal cutter which has just been designed and perfected by the General Electric Company. It is known as "R. B. 40" and is of the rotating bar type. It consists principally of a bed frame of two steel channel bars firmly braced. Mounted upon and engaging with this bed frame is a sliding frame similarly braced consisting of two steel bars, at the rear end of which is mounted an iron-clad multipolar electric motor communicating power to the feed and driving mechanism. The front end of this sliding frame carries the cutter bar, into which the cutters or bits of tool steel are held by set screws. When the cutter bar is revolved, these cutters or bits cover its entire face. The bar is driven by an endless chain, and as it is revolved, is advanced by the feed mechanism into the coal or other material to be cut, to the desired depth, and the cuttings are brought out to the face of the coal by means of cleaner chains. This machine is operated by two men; one in charge of the machine and the other as a helper. A carriage is furnished with the machine which enables it to be handled with ease. The machine is taken into the mine on this carriage and run into the room to be undercut. It is then placed on two skid boards in front of the coal at one side of the room or entry to be undercut, and is fastened firmly by means of the front and rear jacks which are placed against the face and roof of the coal. These prevent the machine from moving when in operation. The power is then turned on by the machine runner, and the machine proceeds to its work.



NEW GENERAL ELECTRIC COAL CUTTER.

The cutter bar, which is revolved by an endless chain, is fed forward to a depth of five or six feet, according to the size of the machine. The usual length of the cutter bar is 39 inches, but 42 or 48 inch bars can be used where the cutting is not too hard. When the full depth is reached, the feed is thrown off, and by means of a reverse lever the cutter bar is withdrawn to its starting point and automatically stopped. This completes the cut, and the machine is moved over the length of the cutter bar used and another cut made in the same manner. This is continued until the entire width of the room or entry is undercut, after which the machine is again loaded on the carriage and taken into another room.

The cuts are made in the short space of time of from four to six minutes. The amount of coal undercut or the lineal feet face for each machine depends upon the quality of the coal and the skill of the man handling it.

ANOTHER INVENTOR OF THE TELEPHONE.

THOSE of our readers who have all along believed that Prof. Bell was the original inventor of the speaking telephone, or perhaps Dr. Gray, and that Blake or Berliner or Reis were the pioneers in the microphone field will be somewhat surprised to learn that the honor of having made the first microphone is now claimed by Dr. R. D'Unger of the D'Unger Long Distance Telephone Company at Chicago.

The Doctor states that as early as Jan'y 29th, 1869, he filed a caveat for his "Electro-Medical Music Box," and that in 1879 a pair of small musical boxes were insulated according to the claims in the caveat and perfect speech was had from them.

The gist of the doctor's invention consists, as he explains, in the fact that by taking two ordinary Swiss musical boxes and insulating the harp plate and frame from the cylinder carrying the note pins and connecting the two instruments by means of a wire carrying an electric current, not only the musical impulses of one of the boxes will be transmitted to the other, but that articulate speech can also be sent over the wire.

Although the doctor makes the above claims and insists that he had a talking machine several years before Prof. Bell and also before Elisha Gray's harmonic telegraphs were known, he makes no claim that he is the discoverer of the art of telephony, but accords that honor to Charles Bourseul, of Paris, France, who in 1854 told in plain words how a telephone could be made and what it could and would do.

THE AMERICAN MANUFACTURING & ENGINEERING COMPANY.

THIS company, whose offices are now located at 143 Liberty Street—Central Building—are the agents for New York and vicinity of the Donaldson-Macrae storage battery. They are also agents for the Ries and Scott fan motor, for the States of New York and New Jersey. These two specialties go very well together, and the General Manager, Mr. William M. Miner, reports a gratifying increase in orders and inquiries.

THE KENNELLY COMBINATION GALVANIC AND FARADIC ADAPTOR.

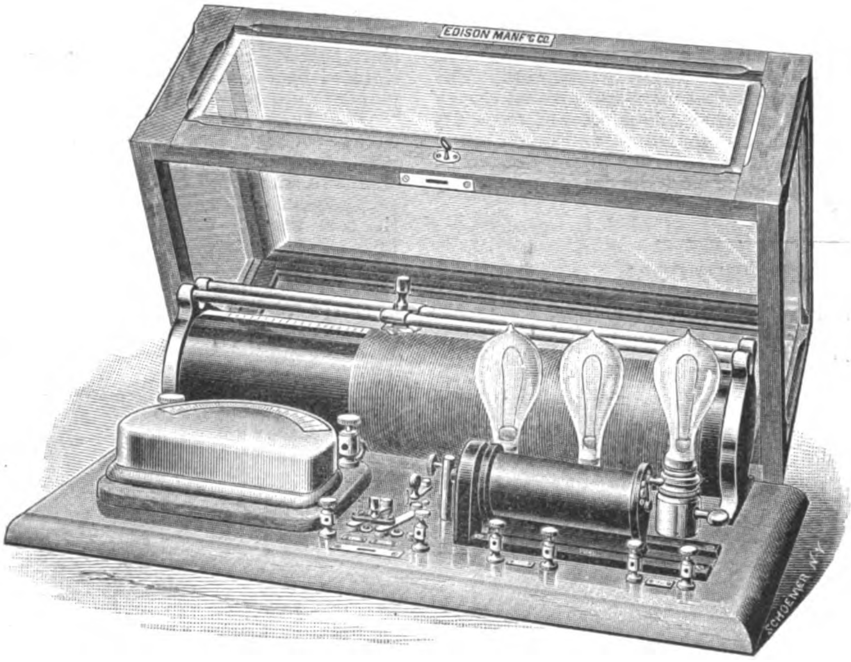
One of the most urgent inquiries of the progressive physician of to-day is for an instrument which he can use with the Edison 110 or 120 volt direct current for all the varied forms of electro-therapeutic treatment with absolute safety to the patient, and at the same time be able to graduate and control it within the finest limits, and also accurately measure the strength of the current he is employing. Such an apparatus is here illustrated as designed by Mr. A. E. Kennelly, with a special view to fulfilling all these requirements.

It consists of a hard rubber cylinder, upon which is wound in suitable grooves, cut on the face of same, several hundred feet of german silver wire, having a very high resistance.

Near the end of the cylinder on the left, very high resistance carbon blocks are introduced into the circuit, making the total resistance about 33,000 ohms. This rehostat is regulated by the sliding contact which travels along the two rods above and parallel with the cylinder.

A 16 c. p. lamp is placed in circuit with each of the leading-in wires to protect effectually the patient and apparatus should a short circuit occur on any part of the electric light circuit.

A third lamp, shown in the extreme right, provided with a key, is arranged in shunt with the rheostat. When the key is turned on, the voltage of the galvanic current is reduced to 60 volts. With this shunt in operation, and all the resistance of the rheostat thrown into the circuit by moving the sliding contact to the extreme left, a current of one milliampere is obtained when the binding posts are connected together by a short piece of wire, *i. e.*, short-circuited. On moving the sliding contact to the right, the resistance is very gradually diminished, and the current correspondingly increased. This finely graduated current is required in some cases, where a very slight irregularity in the current would produce a shock to the patient. When a stronger current is required, the lamp is cut out by turning off the key and the current is used unshunted.


EDISON MANF'G CO.
SCHOENER N.Y.

Kennelly Combination Galvanic and Faradic Adaptor.

The well-known Kennelly milliammeter is mounted on the base on the left, the pole changing switch is placed in the middle of the board, while on the right is shown the faradic coil, which is also operated by the street current.

This is of the Du Bois-Raymond type, the secondary being wound upon a separate spool, removable at will. This secondary winding consists of 18 layers of No. 34 wire, having a total length of about 1,800 yards. The winding is tapped in 6 places, so as to divide the coil into 6 sections, each section consisting of 3 layers of wire, the whole being connected in series. By this arrangement 3, 6, 9, 12, 15 or 18 layers of secondary winding can be used as required, by moving the switch shown at the end of the coil.

Each section produces an entirely different sensory effect, the current in the first section being very stimulating, whereas the current in the sixth section is of a very pleasing character and produces a sedative effect, the character of the current in the other sections being intermediate between the two extremes. When first put in operation, the secondary coil always moved to the extreme right, so as to leave the primary uncovered, the strength of the current being increased by slowly moving it towards the left, so as to finally cover the primary coil.

The current in the primary, on the contrary, is at a minimum when it is entirely covered up by the secondary coil, which in this case, must be short circuited by a switch provided for that purpose, and it is increased by sliding back the secondary coil to the right.

When the switch at the back of the pole changing switch is turned on, and the vibrator set in motion, the current from the galvanic binding posts is now of a pulsating character, as the primary of the faradic coil is superposed on the straight galvanic current, thereby producing the pulsating current as described by Dr. de Watteville. The strength of these two combined currents is controlled by the rheostat in the ordinary way.

It is thus possible to obtain for this instrument, 1st. The direct galvanic current of 120 volts. 2nd. The direct galvanic current of 60 volts. 3rd. The primary faradic current capable of 6 variations, depending on the number of sections of the secondary coil that are short-circuited. 4th. The six secondary faradic currents, all of which manifest distinct characteristics. 5th. The primary faradic current superposed on the 120 volt galvanic current. 6th. The primary faradic current superposed on the 60 volt galvanic current. The instrument is handsomely mounted on a polished quartered oak case and enclosed in a bevelled plate-glass case, provided with a lock.

ROYAL ELECTRIC CO.

The Royal Electric Co., of Peoria, Ill., have recently issued a handsome catalogue of their apparatus for arc and incandescent lighting. Cuts are shown of their alternator, exciter, switchboard, transformers and direct current dynamos and motors. The alternator is built without revolving armature or field coils. The part that revolves is composed simply of substantial, laminated sections of high-grade iron. The transformers are neat, simple and efficient, and range in size from 5 to 100 lights, while the alternators range from 500 to 2,000 lights.

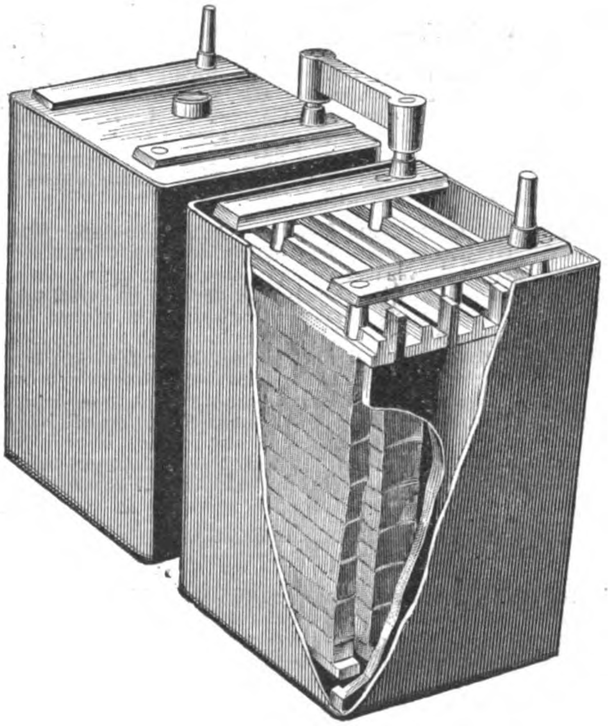
WOTHERSPOON & EVANS.

The above firm has been formed to carry on the business of consulting and supervising engineers, with offices in room 323, No. 136 Liberty street, New York City. The members are H. H. Wotherspoon and Wilbur F. Evans. The former is a graduate of Columbia College, School of Mines, and was formerly in the Inspection Dept. of the Edison Elec. Ill. Co., of New York, and at one time superintendent of the Empress Josephine gold and silver mine in Colorado. Mr. Evans is a Cornell graduate in mechanical engineering and was formerly electrician for the Safety Insulated Wire & Cable Co. The firm will pay special attention to contract and consulting work, and the testing of cables.

CELL OF THE ELECTRIC POWER STORAGE COMPANY.

We illustrate herewith a very interesting form of Planté storage battery recently put upon the market by the Electric Power Storage Co. of New York city, as the result of original work and prolonged investigation. The cut shows the peculiar method of folding up the lead strip, and, as will be observed, an enormous active surface is thus obtained; while certain features are also embodied in the battery which permit of rapid, economical and efficient charging. The construction of the electrodes is such as to give them great strength and solidity, and ability to withstand shock. The plates do not buckle and they can very easily be handled and assembled, as well as connected up with the exterior circuit. Owing to the unusually large surface, rapid discharge does no injury. It is said that the weight of the cell averages about 30 per cent. less than that of others of corresponding capacity. The internal resistance is exceedingly low, being less than .0001 of an ohm. The cell does not suffer from overcharging and its drop in E. M. F. on open circuit is very slight. A trial of the battery, recently reported, was the connection of a group rated to deliver current sufficient for forty lamps, on a bank of 100 lamps, without any damage to it, and with efficiency.

These and other qualities and features have made the manufacturers of the cell very confident of its merit and of its success in the exacting field of storage battery work, whether for lighting, operating street cars, propelling launches, driving fans or any other operation.



THE ELECTRIC POWER STORAGE CO.'S CELL.

ACROSS THE OCEAN IN A SECOND.

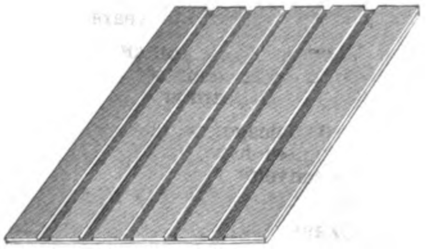
THE result of the Derby race was received by the United Press from the office of the Direct United States Cable Company just one second after it was filed in London.

A FORT WAYNE PLANT FOR GENESEO, N. Y.

THE GENESEO GASLIGHT COMPANY has concluded a contract for a complete electric light plant with W. J. Morrison, State agent for the Fort Wayne Electric Company. The plant will consist of a 60-light Wood arc and a 750-light Wood alternator. The lights have to be in operation by October 1st. A Corliss engine will be used and the plant will be one of the finest in Western New York. Alex. Wyness of Batavia has been engaged as general manager and superintendent by the gas company. Mr. Wyness is a practical gas engineer as well as an electrical engineer. He has had charge of the Batavia, N. Y., Consolidated Gas & Electric Co. for the past four years, and is now installing a municipal plant at Batavia for the Fort Wayne Co. His contract with the Geneseo Co. is for five years.

SCHULTZ GROOVED SABLE RAWHIDE BELTING.

ALWAYS on the alert to keep up with and to anticipate the demands of station managers, the Schultz Belting Co., of St. Louis, Mo., have just brought out their patent grooved sable belting illustrated in the accompanying engraving. The object of this type of belt is to prevent the air cushion, so annoying and so wasteful of power in high speed driving. The air readily finds its way into and escapes through the grooves, leaving the strength of the belt unimpaired and, if anything, increased at the grooves which are kept clean by the constant rush of air through them.



SCHULTZ GROOVED SABLE RAWHIDE BELTING.

The new belt is made of the same material as that which has been so successfully employed by the Schultz Co., consisting of a rawhide tanned only at the surfaces, instead of all the way through, thus retaining an interior of rawhide of great strength and durability.

NEW ENGLAND NOTES.

ELECTRIC HEATING.—A bill to allow cities to furnish electric current for heating has been passed by the Massachusetts House of Representatives.

COE BRASS MFG. CO.—The new boiler house for the Coe Brass Mfg. Co., at Torrington, Conn., will be built by the Berlin Iron Bridge Co., of East Berlin, Conn.

WORCESTER, MASS.—Ordinances have been prepared for the control of electrical wires and providing for the appointment of a supervisor of wires by the Mayor.

THE DAY-MOBERY ELECTRIC CO., of Boston, have removed from their old quarters at 54 Pearl street, to much larger and better accommodations at 185 Franklin St., where they will continue the manufacture of the Jupiter storage batteries and other specialties.

THE NEW YORK INSULATED WIRE CO., have removed their Boston offices from 182 Summer St., to 134 Congress St., where Mr. Walter S. Barker will continue as selling agent, and carry a full line of the well-known Grimshaw wires, cables and tapes, and the Vulca wire ducts and bushings.

MR. F. A. SCHEFFLER, who has been connected with the Stirling Company for the last year as its sales agent in New York, has gone to Boston where he will co-operate with Mr. J. Bradford Sargent, the New England representative of the Stirling Company, in his efforts to bring the Stirling more prominently before the steam users of that section. Mr. John MacCormack, who is very well and favorably known to the boiler trade throughout the East, succeeds Mr. Scheffler as Manager of the New York office of the Stirling Company.

THE HIGHAM ELECTRIC CO., of 164 High street, Boston, announce that they have commenced the manufacture of arc lamps for incandescent circuits, and have leased a large and commodious factory for that purpose. Mr. Higham claims to have an arc lamp that will distance any competitors, having entirely eliminated all necessity for a dead resistance in the lamp, thereby getting 95% of the total energy usefully in the lamp. This result is achieved by the use of an induction coil outside the lamp which consumes 5% of the energy, and it is claimed that as much as 92% of the total energy is given out at the arc. Professor Hooper has made several tests of the Higham lamp, and states that two-thirds of the power usually wasted in other lamps in the dead resistance, is saved by the method used in the Higham. The lamps can be seen in operation at any time in their office in Boston.

SOUTHERN NOTES.

MR. J. F. MORRISON, Baltimore, has been made a party to the big attachment by the General Electric Co. on the property of the Fort Wayne Electric Co., the object being to get hold of any Fort Wayne property there might be in Maryland.

WESTERN NOTES.

Mr. M. E. Baird, of the Eddy Elec. Mfg. Co. has been here in the West in the interest of the company's Western trade.

Mr. Maurice E. Bates, superintendent of the National Electric Co., Eau Claire, Wis., paid a short visit to Chicago last week.

The Simplex Electrical Co. have opened a Chicago office at 1137 Monadnock Block, in charge of Mr. H. R. Hixson as Western manager.

The Beacon Vacuum Pump and Electrical Co. are now represented in the West by Messrs. T. C. Rafferty & Co., 323 Dearborn street, Chicago.

Roth & Eck, Chicago, report an increasing demand for their latest type fan motors. They are handsomely gotten up and are claimed to be very economical.

Watsonville, Cal.—Mr. Howard V. Trafton has the contract for a city fire alarm system, for which the city leases 14 boxes from Mr. Trafton for a term of 3 years.

The Central Electric Company, Chicago, are fitting up an elaborate switchboard in their store, showing a complete line of Interior Conduit Switchboard appliances.

Osburn Bros., Chicago, who some time ago started in the electrical supply business have already found it necessary to hire larger and more convenient quarters, and have just moved to 304 Dearborn street.

Mr. Reid Carpenter, president and gen'l manager of the Card Electric Company, Mansfield, O., was in Chicago last week concluding arrangements with Mr. J. Holt Gates, whereby the latter will act as Western representative for the sale of that company's street railway motors. Mr. Gates reports the sale of 17 car equipments as a starter in that line.

The Northern Electric Railway, Chicago.—The ordinance giving franchise to this company, covering several streets in the 27th ward, was favorably reported to the city council by the committee and that part of the city has a fair chance of getting rapid transit. The original ordinance had several objectionable features which, however, were eliminated by the committee.

The Wallace Electric Co., Chicago, are now carrying a most complete line of fan and larger ventilating motors adapted to all circuits, and with the summer season right on us they report a gratifying demand for goods of that kind. In addition to motors suitable for use on regular commercial circuits, they offer a small fan motor and battery outfit for places where no other circuit is available.

The Electric Appliance Company are doing a rushing business with the Meston alternating fan motor notwithstanding the fact that the cool temperature has been rather against that electrical appliance. Hot weather is sure to come, however, and at least some of the trade believe in being prepared for it when it does come, instead of having to take their chances with the rest in the rush. The Appliance Company are also exhibiting a line of the Carpenter electric heating and cooking appliances in their Madison street show windows, which are attracting considerable attention.

The Creaghead Engineering Co., 296 Plum street, Cincinnati, O., electrical engineers, contractors, etc., have issued a very handsome catalogue of their electric railway overhead line material. It includes their line insulators, curve insulators, pole bracket insulators, car barn, mine and bridge insulators, goose neck curve insulators, trolley section insulators, adjustable pole brackets, overhead frogs and switches, overhead crossings, pins, lag screws, brackets, eye bolts, ratchets, glass insulators, station and line switches, span wires, insulated wires, trolley wires, Garton lightning arresters, Wurts arresters, arc lamp pulleys, and other specialties and appliances. Prices are quoted, with a full set of cipher words for ordering by telegraph.

NEW YORK NOTES.

The Long Island Ry. are equipping a portion of their road with the Johnson block signal system. It will first be constructed as far as Jamaica, and probably extended later. "Ideal" insulated wire is used, 20 miles being required for the first part of the work.

The F. P. Little Electrical Construction & Supply Co., of Buffalo, have just moved their factory into larger and better quarters, and are now fully prepared to take care of and execute promptly all orders entrusted to them, for the lines of goods with which they are identified.

The Fort Wayne Electric Corporation has already ripped its offices out of 44 Broad street, and has established itself at the old-time headquarters, 115 Broadway, where once again the president, Mr. R. T. McDonald, will be glad to see his friends and those of the Company, when he is in town.

The Western Union Telegraph Co. has earned and will pay its regular quarterly dividend of 1¼ per cent. It has curtailed expenditures, but has wisely refrained from cutting the wages of the operators.

Mr. W. A. Vail, who closed out recently his interest in a number of valuable electrical specialties, has now joined the ranks of the American Telegraph and Telephone Co. (the long-distance Company), and will hereafter devote his energies to that important field, in which he is already well known, as an old telephonist.

Mr. Walter K. Freeman, of 136 Liberty St., has closed a contract with the Gold Bluff Mining Co., Downingville, Cal., for one 85 K. W. compound wound direct current generator, one 85 H. P. iron-clad hoist, one 5 H. P. triplex pump and one 3½ K. W. compound wound dynamo and fixtures for a special lighting plant. This is an addition to a 200 K. W. outfit for the stamp mill purchased by Mr. Freeman last March.

The United States Head-Light Company, of Utica, N. Y., has purchased of M. M. Buck & Co., The Dayton Manufacturing Co., Kelly Lamp Co., Steam Gauge & Lantern Co., I. A. Williams & Co., and The Adams & Westlake Co., the machinery, tools, patterns, etc., constituting their head-light business, together with thirty-two letters patents and a number of applications for patents, covering standard devices for illuminated numbers and signals in head-lights and other desirable improvements.

Brooklyn, N. Y.—Franchises have been granted in Brooklyn to the State Electric Light & Power Co. and the Kings County Electric Light & Power Co. Each company is to pay the city $500 a year and 1 per cent. of the gross receipts. Noah L. Cocheu is president of the State Co. and M. L. Towns president of the Kings County. The Supervisor at Large has vetoed a resolution by which the Board of Supervisors had been authorized to make a contract for telephones to be put in the houses of the Commissioners.

The Central Electric Heating Co., Havemeyer Building, this city, have just issued a very dainty and pithy little brochure or leaflet, giving details as to a large variety of their cooking and heating apparatus. It is a treatise on the art in brief, and is so prettily illustrated that almost everybody into whose hands it falls will be tempted to read it through. Such a pamphlet must greatly stimulate inquiry, and we all know that goods talked about are half sold, needing little further effort to win over the purchaser. There is still so much pioneer work to be done in the electric heating and cooking field, in the education of the public, we cannot too strongly recommend our readers, especially those who are central station men, to do all they can to put this leaflet in extensive circulation. We may add that it is printed by the Bartlett Co.—which tells all that is necessary as to its artistic merits.

PHILADELPHIA NOTES.

The Miller Electrical Works, of 4 No. 5th St., have secured the agency for Philadelphia for the Garton-Daniels lightning arresters so favorably known among the trade. The Miller Co. are about to bring out a line of all copper quick break knife swift switches, and several other electrical specialties.

Queen & Co., Philadelphia, have placed upon the market a new tachometer for measuring the instantaneous velocity of shafts. This measurement being of great importance they have given a great deal of time to the production of an instrument which should obviate troubles in previous designs. The portable tachometer, reading from 40 to 3,000 revolutions per minute, is a particularly valuable instrument. Three spindles are geared to the rotating parts, each having a separate scale on the dial so that the instrument is direct reading throughout its range. A detachable joint is supplied with an end slightly flexible, transversely fitting any of the spindles. The flexibility acts as a safeguard against breakage, in cases where the tachometer shaft is not applied exactly parallel to the shaft whose speed is to be measured. The scales are graduated from 40 to 200, 120 to 600 and 600 to 3,000. A full description may be obtained by writing to the makers.

CANADIAN NOTES.

The Niagara Falls Power Co. has now closed its contract with the Canadian authorities, and its Canadian branch will at once proceed with the excavations under Queen Victoria Park.

The Babcock & Wilcox Co.'s Canadian headquarters have been removed from Deseronto, Ont., to 415 Board of Trade Building, Montreal. Mr. E. C. French is general agent for Canada.

☞ Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.

THE
Electrical Engineer.

Vol. XVII. JUNE 27, 1894. No. 321.

ELECTRICAL RESONANCE AS RELATED TO THE TRANSMISSION OF ENERGY.

BY

Wm. A. Anthony.

MUCH interest is being taken at the present time in the subject of electrical resonance; and the possibility of taking advantage of this condition in the use of electrical apparatus, especially in the transmission of energy, has been discussed, and some of the conditions necessary to its successful employment have been pointed out. The conditions of electrical resonance itself have been investigated analytically and many interesting results have been derived by various writers; and Dr. Pupin in a lecture before the American Institute of Electrical Engineers in May, 1893, gave a most clear and beautiful popular exposition of the subject. In this lecture Dr. Pupin made most excellent use of mechanical analogies, and demonstrated his deductions by a series of very successful experiments. In this discussion Dr. Pupin confined himself to the conditions necessary to establish resonance and the effects produced when the circuits were properly tuned. He did not attempt to discuss the question of taking advantage of resonance in the electrical transmission of energy.

In a series of articles by Mr. F. W. Dunbar now (May, 1894), appearing in the *Electrical World*, it is shown by mathematical analysis that when a circuit is tuned to unison with a source of alternating E. M. F. a greater current may be transmitted to a distant point by a given E. M. F. than when the circuit is not so tuned. Although Mr. Dunbar states that his results indicate that copper may be saved in lines used for the transmission of energy, by tuning them in unison with the source, he does not point out how the condition of resonance upon the line is to be utilized for the transmission of energy or what will be the effect upon the line when the conditions of resonance obtain.

In what follows I propose to consider the subject entirely in the light of mechanical analogues with which every student of physics is familiar, and shall try to point out by reference to familiar experiments with vibrating bodies just what we may expect when we attempt not only to maintain by resonance a given current upon a circuit, but also what conditions must be fulfilled and what results will follow when we attempt to transmit energy to a distant point.

I ought, perhaps, to apologize for treating the subject in the extremely elementary way I have adopted, but the principles of the transmission of vibrating motion, and the various phenomena connected with it, the formation of stationary waves, the relation of a periodic force to the motion produced by it, are so outside our ordinary experience and involve such entirely new sets of ideas and new trains of thought, that I believe many readers will be glad to start at the foundation principles. I have, therefore, at the risk of appearing diffuse, detailed at some length the elementary phenomena connected with the foundation of stationary waves.

In Mr. Dunbar's articles he frequently compares a non-resonant circuit to a light, slack string in which the wave impulses rapidly die away, and, as he says, "are absorbed by the string and their energy dissipated in the form of heat." This does not seem to me a fair comparison. A slack string does not absorb any considerable amount of energy, nothing like what is absorbed by the same string tuned to unison with the exciting source, because it is impossible to impart to it so great an amount of motion. The familiar experiments of Melde, in which the laws of vibration of strings are illustrated by the use of tuning forks as the vibrating source of energy, will illustrate this point. So long as the string is out of unison with the fork, either from being too slack or too tense, the vibrations of the fork die away very slowly, but as the tension of the string, or its length, is varied to bring it into unison with the fork, the string will, when the unison point is reached, suddenly assume a vibration of wide amplitude and the fork will be very quickly brought to rest. So long as the string is out of unison its motion is small and it absorbs very little energy. When in unison its motion is large, it quickly consumes the energy stored in the fork and brings it to rest. The energy of the fork is not transmitted, it is simply absorbed and dissipated in consequenee of the great velocity at the antinodes of the string due to the wide amplitude. Dr. König, the well-known investigator and manufacturer of acoustic apparatus, once told me that some one had discovered and complained to him that the resonant boxes on which his tuning forks were mounted were not in exact unison with the forks. "But," said Dr. König, "if I made them in exact unison the air would rapidly absorb the vibration, the fork would be quickly brought to rest, and then they would complain that my forks were not well going."

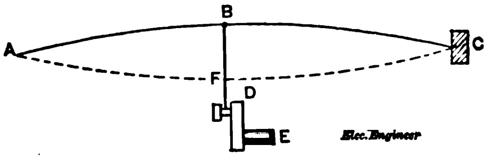


FIG. 1.

So in a non-resonant electric circuit fed from an alternating source, a given current may be maintained by a given E. M. F. Tune that circuit to unison with the source without changing its resistance, a sudden increase of current will occur, accompanied by an increased absorption of energy, not because energy is *transmitted*, but because it is absorbed and dissipated by the circuit.

Let us now consider the case of the transmission of energy for some useful purpose. A vibrating string might be used to transmit energy by connecting it at an antinode to some device by which motion could be imparted to a machine. In Fig. 1 let A B C be a string attached to a fixed support at C, and at A connected to some source of energy capable of maintaining a constant vibration in the string. Let the point B be connected to a crank D in such a way that the vibration of the string causes the shaft E to revolve. It is supposed that the vibration is maintained by properly timed impulses at A where the motion is very small compared to the double amplitude B F at the antinode. It is plain that the mass of the string must be such that its inertia is sufficient to more than supply the force required to revolve the shaft E. That mass must be assumed, therefore, not only with reference to tuning the string to unison with the source of energy at A, but with reference to the work to be done. It is plain, also, since energy is force multiplied by the space through which it acts, that whatever force is exerted by the string over the space B F to revolve the crank, a force greater in proportion as the movement is smaller must be applied to the string at A to maintain the motion.

Again, suppose the string to be divided by a node in the middle as in Fig. 2. The energy imparted to the revolving shaft from the point B must now be transmitted from A through the node N. But since N is a place of comparatively small motion the force exerted there must be proportionally large. The connection to the crank might be made from the node N and the power transmitted by means of the large force and small motion that occur there.

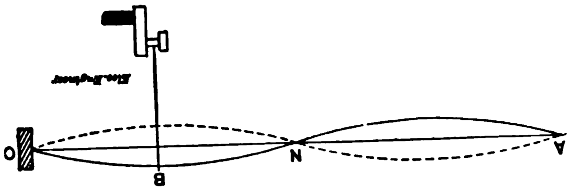


FIG. 2.

Consider now the apparatus represented in Fig. 3. Let the cylinders and connecting tubes be filled with an elastic fluid. Suppose the piston in G to have a reciprocating motion. It will alternately compress and rarefy the fluid at C D F E and the piston M will be subjected to varying pressures tending to move it in synchronism with G. The apparatus is a transmission system in which G is the generator and M the motor and C D F E the conducting circuit. If we assume the fluid to be perfectly elastic and that no loss occurs from the compression and rarefaction, the only loss in transmission is that due to friction in the connecting pipes.

Now we can assume for this apparatus such a fluid, of such a mass and elasticity, that for a certain period of vibration of the piston G the fluid in the pipes C D and E F would tend to vibrate in the same period like the air in an organ pipe, with a node in the middle, as shown by the dotted lines at A and B. In order that energy may be transmitted under such conditions it is necessary that the fluid should have such a mass that it may in virtue of its inertia absorb the energy of the generator and then deliver it to the motor. It is no longer merely a medium for the transmission of pressure, but a medium for the absorption and redelivery of energy. As in an organ pipe, the nodes A B are places of comparatively little motion, the fluid on opposite sides of A and B moving in opposite directions, as shown by the arrows. Only at the ends of the pipes near the cylinders is the motion as great as in the non-resonant pipe throughout its whole length. The loss from friction in the resonant pipe is, therefore, much less and the system of transmission is much more efficient. But since the energy must be transmitted through A and B there must come with the diminished motion a corresponding increase in pressure. If the motion at A is one-tenth as great as near the ends at C and D, the force or pressure exerted at A must be ten times as great.

But now the question arises, if the pipe is strong enough to bear the pressure to which it is subjected at A, why may it not bear that pressure throughout its length, and then why not discard the condition of resonance, use the high pressure and small motion throughout the length of the pipe, and so reduce the friction losses all along the pipe to the value they previously had at the nodes? In short, the power transmitted by a belt, a cord, a fluid, is the product of two factors, force or stress, and velocity. If one is diminished the other must be increased. In transmission by means of a fluid, as in the case we have considered, friction losses may be reduced by reducing the velocity and increasing the pressure to the highest practicable limit, and the least loss from friction will occur when the highest practicable *uniform* pressure and the lowest velocity is used throughout the length of the pipe. For, if a variable pressure is used, its mean value will be less than (since its maximum value can only equal) the constant pressure that might be employed, and the mean velocity and frictional losses must be greater than would correspond to the constant pressure.

This will be entirely clear to those who are familiar with the mathematics and mechanics of wave motion. But to make the subject plain to those who are not familiar with the mathematics let us go back to first principles and trace out what takes place in the different parts of the circuit represented in Fig. 3.

I must assume that every one knows that when a disturbance is produced at a given point in an elastic fluid that disturbance is propagated with a certain finite velocity which is greater, the greater the elasticity, and less, the greater the density of the fluid. If a disturbance be produced at G, Fig. 3, if for instance, G be suddenly moved toward C, the fluid immediately in front of G is moved forward, causing a compression, by this compression the motion is communicated from particle to particle at a certain definite rate, and, in a certain time, travels round the system of pipes and returns to the starting point from the direction E. This time of traveling around this system of pipes depends only upon the nature of the fluid and not at all upon the nature of the disturbance, so long as the disturbance is not too great.

Now suppose the piston G to be moved back and forth through a small distance just as the piston of an engine moves in its cylinder, and suppose the complete period of its vibration be exactly the time required for a disturbance in the fluid to travel completely around the circuit. When G starts toward C a wave of compression is started in front of it, and traveling through C, A, D, reaches M just as G has completed half its period, that is, just as it reaches its farthest point toward C. G then begins to return, starting a wave of compression toward E, and these two waves of compression, the one that has just reached M on the way round toward F and the one just starting from G, traveling with equal velocities, meet at B, and since the particles of the fluid at B tend to move to the left by one impulse and to the right by the other, they do not move in either direction, but the two compressions are added, causing a double compression. In consequence of this compression the particles tend to move from B in both directions and the effect is the same as though the two impulses which met at B continued on unchanged, the one toward G and the other toward M. Following the one toward G, it reaches G, having made the complete circuit, just as the piston completes its vibration and is on the point of returning toward C. It is aided in its return by the impulse which its previous

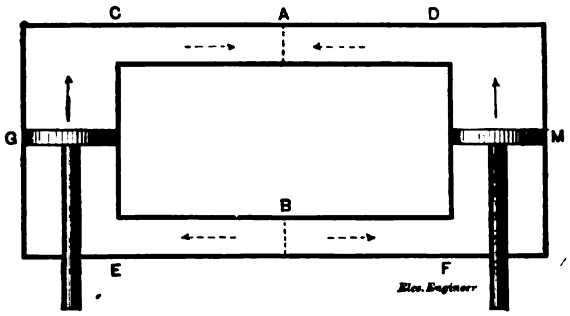


FIG. 3.

motion started, and which has just completed the circuit of the system.

But to go back to the first movement of G; when it first started toward C and so started a compressed wave in that direction it left a rarefied space behind it. Into this space the particles are pushed by the elasticity of the fluid and this disturbance in which the fluid particles are all moving toward the piston, moves back through E and B and reaches M at the same time as the other disturbance traveling through C and A. Although the disturbances or wave impulses are traveling in opposite directions, they both tend to move the particles at M in the same direction, toward F, and M, therefore, moves in that direction with a double impulse. It will be noted also that both impulses reached M just as G is on the point of returning toward E. G and M, therefore, move together, the one toward E and the other toward F.

If we continue the analysis of the motion we shall find that G and M are always moving synchronously and the fluid is, therefore, undergoing compression in one branch at C D while it suffers a rarefaction in the other. It will be seen too, that A and B are planes of no motion but of greatest rarefaction and condensation and, therefore, greatest variation of pressure.

It will be noted that the condition that brought about this state is, that a motion of the fluid particles started by the piston G, is transmitted from layer to layer around the circuit, returning to G *just as* G *is ready to impart a new impulse in the same direction.* This will occur if G makes one, two or more *complete* vibrations during the time required for an impulse to travel around the circuit. If G makes one vibration in this time, we have the condition shown in the figure with nodes at the middle points A and B of the tubes. If G made two vibrations in the same time it would be easy to show that instead of the nodes A and B there would be four nodes dividing the circuit into four segments.

Since at each return of the transmitted movement to G it finds G ready to give a new impulse adding to the motion already existing, the effect of the impulses at G is cumulative, and, if there were no loss from friction or otherwise, it would require but a few small impulses at G to set up a powerful vibratory motion in the tube. Assuming that there was no friction and no energy taken from the system in any way, such a vibration once started would never cease.

It will be plain that when this vibration has become established, all the particles of the fluid between G and A and between M and A move toward or from A simultaneously, and that as we recede from G or M the amplitude of the motion continually decreases until at A it is zero. Such a wave in which all the particles between two adjacent nodes move simultaneously in the same direction is called a *stationary wave.*

But while the particles at M and G move over the greatest distances, the particles adjacent to these move over so nearly the same distance that there is very little approach or recession and consequently very little change of pressure, while the contrary is the case near A and B.

Consider the particles at G and M to be moving at their greatest velocities toward C and D through their positions of equilibrium. They are gradually brought to rest at the extreme point of the vibration by the small opposing elastic force of the fluid. Their kinetic energy is absorbed by a small force acting over a comparatively large space. As we go toward A, however, the space becomes less and less and the force, as it should do, becomes greater and greater. It may be considered that the kinetic energy of the particles at M is transferred from particle to particle back through D and A toward G. At the same time the kinetic energy at G is transmitted through C and A toward M. On the supposition that no energy is lost to the system, an equal amount of energy is transferred through A in each direction and the particles at A remain at rest.

Now suppose the particles or piston at M be called upon to do outside work. On the same supposition as before, that M is moving toward D, since part of its energy is consumed by the outside work only a part is transferred through A to G, hence G receives less energy from M than would have been received if M had not done any outside work.

There is then a lack of energy to maintain the vibration at G and unless energy is supplied, the whole system will soon be brought to rest. Let energy be supplied to G. It must come from a periodic force tending to maintain the vibration. Such a force acting upon G through its amplitude imparts energy to the fluid which is transferred through A and B to M to make up for that taken away from M. But now since more energy is transmitted in one direction than the other through A and B, the particles there can no longer remain entirely at rest. The amount of motion at A and B will depend upon the relation that the excess of energy transferred in one direction over the other, bears to the whole energy transferred, and in order that the nodal character of A and B may be maintained, it is important that this excess of energy should be small compared to the whole.

This leads to a most important consideration, that if the resonant character of the system is to be maintained the energy taken from M must be only a fraction of that stored in the vibrating system. It should be noted further that when energy is taken from M, and consequently motion takes place at A and B, the motions of G and M, although always isochronous, are no longer synchronous, and the departure from synchronism is greater as the amount of energy used is greater.

Bearing in mind the relative motions of the various particles of the vibrating fluid, it will now be clearly seen that the energy required to make up for that lost to the system, which is applied in the form of a force acting through the comparatively large space represented by the amplitude of vibration at G, as it is transferred toward A and B to particles whose range of motion is less and less, must appear as a greater and greater force acting through a smaller and smaller space.

Considering now that when vibration takes place without loss to the system the nodes A and B are places of great elastic stress, while at G and M there is almost no stress whatever, and that when force is applied at G to make up for the loss in the system, that force is magnified at A and B and appears there as an added elastic stress, it becomes evident that under such a system of transfer of energy the pressure at the nodal points must be many times greater than elsewhere in the system.

We may now apply these considerations to an electric circuit. Difference of potential or electric stress corresponds to pressure or elastic stress in fluids. Electric flow corresponds to fluid flow. Electric current corresponds to velocity. Self-induction is a sort of electric inertia corresponding to mass inertia. Elasticity in a fluid corresponds to the rate of change of electric stress with charge. That is, the elasticity of a fluid is the ratio of any small change of pressure to the corresponding change of volume. So we might call electric elasticity the ratio of any small change of electric pressure to the corresponding change of charge. Obviously the change of pressure (electric) due to the unit change of charge will be inversely proportional to the capacity of a body.

It is obvious that an electric impulse or displacement will travel on a conductor with a perfectly definite velocity depending upon the electric inertia or self-induction which tends to hold back or retard the motion, and the electric elasticity which tends to hasten it. Such a propagation results in a stationary wave if impulses are properly timed, precisely as in a vibrating string or organ pipe, or in the fluid circuit represented in Fig. 3. Such a stationary wave must have its nodes where there is no current, just as the string or organ pipe has nodes where there is no motion. That such nodes exist in a resonant electric circuit is demonstrated by the fact that less energy is lost on a resonant circuit than on a continuous current circuit carrying the same current as exists at the terminals of the resonant circuit. For, since the energy lost in the resistance of the circuit, is $C^2 R$, the loss can only be diminished by diminishing C, and if $C^2 R$ is less on the resonant circuit than on the continuous current circuit, it is plain that the mean C^2 must be less, and hence that C along the line of the resonant circuit is less than at the terminals. In fact, if we assume a simple harmonic wave and nodal points of absolutely no current, the current strengths along the circuits will be represented by a sine curve, and the mean C^2 is in that case just half the maximum C^2. Hence just half the energy is saved, or we can waste the same amount of energy and save 50 per cent. of the copper in the line.

Such a node of absolutely no current cannot, however, exist if any energy is lost to the system either as waste, dissipated from conductors, or as useful energy taken from translating devices. In this case, just as in the vibrating string or fluid circuit, more energy is transferred through the node in one direction than in the other, and this cannot be without some current. It is plain, therefore, that in any practical system of transmission, not quite half the copper can be saved by tuning it to resonance.

But let us consider the other conditions that must exist on a resonant circuit.

Just as we have already found for mechanical resonance, so in electrical resonance, the inertia must be large in comparison to the energy to be taken from the system. In other words, in order that resonance may be maintained, the self-induction of the circuit must be such that energy may be stored in it, in amount several times what it is proposed to take away. This requires a relatively large electrical elasticity which may be obtained by making the capacity small.

As in the resonant fluid the nodes of no motion are the places of greatest pressure, so in the electric circuit the nodes of no current are places of greatest electric stress. In other words, the antinodes of the curve of stress correspond to the nodes of current, and vice versa.

It will be remembered that the condition of resonance in the fluid system of Fig. 3 was that any given movement started by the piston G must, after traveling completely round the circuit, return to G to find the piston moving in the same direction; that is, the impulse given by the piston must always coincide in direction with the motion the fluid already has from previous impulses. So with the electric circuit, and for the same reason, the condition of resonance is that the impulses given by the generator to compensate for the energy taken from the system must always coincide in direction with the current already established; or in other words, *the phase of the impressed electromotive force must coincide with that of the current.* But just as the pressure exerted by the piston G is multiplied as it passes through the nodes A and B, so the electric pressure of the generator must be multiplied as it passes through the points of minimum current. These points are, therefore, for two reasons, points of many times greater electric stress than exists at the terminals of the line, and the question at once arises, as in the case of the fluid transmission, if the insulation of the line will bear this great electric stress, why not so design the system that this stress with its accompanying small current shall exist throughout the line.

All this might have been said in a very few words. Every one familiar with the characteristics of harmonic vibration and wave propagation, knows that the force is a maximum when the velocity is a minimum and the velocity a maximum when force is a minimum; and that for all stationary waves, the two curves representing respectively force and velocity at different points, the ordinates of one are always a maximum where those of the other are a minimum.

An electric circuit tuned to resonance with the generator, affords an example of a stationary wave where the maximum current is at the generator and motor and the minimum current at the nodes on the line. This gives a minimum of energy consumed in the transmission. But the E. M. F. curve has its nodes at the generator and motor and its antinodes correspond to the nodes of the current curve on the line. Therefore, whatever the electric pressure at the generator and motor, they must be small compared to the pressure on the line at the current nodes.

While, therefore, a line tuned to resonance with the source may transmit energy with less $C^2 R$ loss, we must, to secure that result, give to it a self-induction capable of storing several times the energy it is proposed to transmit, and subject it to electric stresses several times what would be required with the same current to develop the power consumed.

AN ELECTRIC LOG.

ADMIRAL FLEURIAIS, of the French navy, brought out an electric log which was tried on the "Magicienne" in 1878. It may be described as a small watermill with a wheel consisting of cross-arms tipped with cups like the anemometer of Robinson. There were two sets of four cups mounted on the ends of the same axle, and as they revolved in the water while the ship moved, a contact on the axle interrupted an electric current flowing through a wire between the ship and the log, and sounded a telephone. The note given out by the telephone was a measure of the number of revolutions per minute of the log and of the speed of the ship. At high speeds, however, the ear was not quick at recognizing the note, and Admiral Fleuriais has substituted for the telephone an electric bell, which is struck every 24 revolutions of the mill wheel or vanes. By timing the interval between two strokes of the bell the speed of the ship is obtained. The apparatus has been tried on board the "Ocean" and other men-of-war, and recently adopted by the Minister of Marine.

REVERBERATORY FURNACE WITH MOVABLE ELECTRODES.

IN the *Compt. Rend.* M. Moissan describes a reverberatory furnace with movable electrodes. The furnace consists of a parallelopiped of Courson limestone, in which is cut a somewhat large cavity, also a parallelopiped in shape, which is lined with alternate plates of magnesia and carbon, about 10 mm. thick, so arranged that magnesia is in contact with the limestone, whilst carbon forms the internal lining of the cavity. A lid, of alternate plates of magnesia and carbon, covers the cavity, and a block of Courson limestone is placed above this lid. The electrodes are movable, and pass through slots cut in opposite side of the furnace. At right angles to the electrodes a carbon tube, 10 mm. to 20 mm. in diameter, passes through the furnace, and is so arranged as to be 10 mm. below the arc and 10 mm. above the bottom of the cavity. If necessary, the tube can be lined with magnesia. By inclining the tube at an angle of about 30 degrees, the furnace can be made to work continuously, the reducible material being introduced at the higher end, whilst the product of reduction is drawn off at the lower end. With a current of 600 amperes and 60 volts, two kilos of fused metallic chromium can be obtained in about an hour, the metal being received in a crucible made of chromic oxide. The metal is white, finely granular, and very hard, and takes a high polish. The magnesia is prepared by heating strongly the basic carbonate, digesting the product with ammonium carbonate solution, and again strongly heating. It is then moistened with water and compressed. With this furnace, silicon carbide and vanadium carbide can be readily obtained by the direct combination of carbon vapor with the vapors of silicon and vanadium.

ELECTRIC TRANSPORTATION DEPARTMENT.

ERIE CANAL TRACTION COMPANY.

Articles of incorporation of the Erie Canal Traction Company were filed recently at Albany. The objects for which the company is formed, including the nature and locality of its business, are as follows: It is to produce, purchase, sell, and distribute power in the form of electricity or otherwise, for the propulsion or traction of boats and vessels upon the Erie Canal; to lay, build, and erect all machinery, storage batteries, conductors, and other apparatus of every kind incidental to the said business, and to furnish, sell, and distribute along the line of the said canal, and in the cities and villages adjacent thereto, power for any purpose incidental to the said business. The capital is placed at $100,000, with power to increase to $4,000,000. The principal business office will be in New York City, and the duration of the company is fixed at fifty years.

The directors for the five years are: George G. Haven and Richard S. Hayes of New York, representing the Metropolitan Traction Company of New York City; the Hon. Thomas C. Platt of Owego, Adrian Iselin, Jr., of New York, a banker; Baron Louis A. Von Hoffman of New York City, who is the head of the foreign banking house of Von Hoffman & Co.; Alfred S. Heidelbach, head of the foreign banking house in New York City of Heidelbach & Ickelheimer and Charleton T. Lewis of New York City, counsel for the Mutual Life Insurance Company and secretary and treasurer of the Cataract General Electric Company. The incorporators of the company are: Frank W. Hawley, Vice-President of the Cataract General Electric Company, and the gentlemen named as directors.

TROLLEY EXTENSIONS IN BROOKLYN.

More electric roads will soon be in operation in Brooklyn. The Broadway Railroad Company, which is now controlled by the Brooklyn Heights Company in the interest of the Long Island Traction corporation or syndicate, is relaying its tracks, and putting in trolley wires and poles in Broadway, Reid, Sumner, and Ralph Avenues, and a score of miles will be completed next month. This is the last of the important lines in the city to be equipped for using trolley traction. In the new Twenty-ninth Ward the Nassau Electric Company is building a new road, to run from the Thirty-ninth Street Ferry in South Brooklyn to Canarsie. It is promised to be ready by July 15. As the route crosses the Ocean Parkway, the great drive from Prospect Park to Coney Island, there will be some delay in running through cars. The park commissioner has refused to permit a grade-crossing. The company at first proposed to tunnel the drive, as has been done for the Bay Ridge branch of the Manhattan Beach Railroad, but now it is proposed to swing an iron bridge over the drive. As it will have to be 210 feet long, with approaches, it will take some time to construct it. The Nassau Company will also build a line in Marcy Avenue from Canarsie to the Broadway Ferry.

A DECISION AS TO GUARD WIRES.

An important decision relating to the right of cities to restrict dangerous overhead wiring has been rendered by the Supreme Court of Wisconsin. The city of Janesville enacted an ordinance providing that guard wires be placed where they would prevent the contact of telephone wires with the wires of the electric motor company. The power of the court to compel the street railway company to comply with the ordinance was invoked by mandamus. An appeal was taken to the Supreme Court, and the court sustained the validity of the ordinance.

TROUBLE FROM DEPRESSED RAIL JOINTS.

The trouble that may come from bad rail joints was instanced a few days ago in Detroit, when striking such a joint the car was turned completely over, and many passengers were buried beneath it, though fortunately none was killed. This leads the Cleveland papers to call out for fewer bad joints and heavier rails.

ONE PLAN OF IDENTIFYING TROLLEY "TRANSFERS."

The Lynn & Boston Street Railway has some new transfers with pictures of men without moustaches and side-whiskers and women with hats or bonnets in the upper corner of the ticket. The conductors are to punch out the picture nearest like the holder of the ticket. The conductors are to take a course of study in millinery at their earliest convenience.

THE TOLEDO, MONROE AND DETROIT ELECTRIC RAILWAY.

The right of way for an electric railway between Toledo and Detroit via Monroe, has been secured and work upon the road will soon be commenced. The route will be along the old United States turnpike which runs in a straight line nearly the entire distance, and the construction will, we are informed, be first class in every respect. Sixty pound steel girder rails will be employed. The road will be about sixty miles in length, and four power houses will be required.

BIG TROLLEY TRAVEL IN BROOKLYN.

According to Auditor Bernard Mullen, the different lines of the Brooklyn City Railroad on Sunday June 17, carried over 500,000 people. This is an excess of 50,000 over the previous Sunday, when the largest travel in the history of the corporation was first noted.

EMPLOYING HOME LABOR.

Several trolley roads have yielded to local agitation on the subject of employing foreign labor, and are giving preference to home talent.

LETTERS TO THE EDITOR.

THE NIAGARA TRANSMISSION.

I have just read the reply of Messrs. Houston and Kennelly to my article on "Economy in Long Distance Transmission of Power by Electricity." My fourth equation, as it stands, of course represents the cost *per mile* due to conductors of conveying energy, *P*, over the distance *d*. It was a slip in copying that produced the error in my manuscript.

I am surprised to find that Messrs. Houston and Kennelly have fixed their limit of pressure with reference to danger from manipulation. Since their scheme involved the use of step-up and step-down transformers there was no question of manipulating the high potential at the receiving end, and if there were I do not know of any experience that should lead us to settle on 35,850 volts as a safe pressure to manipulate.

The question of the limiting pressure, as I have always understood, relates to insulation on the line. It has generally been conceded that we could at both generating and receiving end, by means of step-up and step-down transformers, if not otherwise, take care of any pressure that could be practically used on the lines. Probably, as Messrs. Houston and Kennelly say, in view of the Lauffen-Frankfort experiments, "30,000 volts effective is a pressure that may be reasonably assumed as practicable;" but I cannot see how that warrants them in assuming 64,000 volts effective as practicable.

I wish to call attention to the fact that I did not *assume* 24,500 volts effective at Albany, as might be inferred from the wording of Messrs. Houston and Kennelly's reply. Had I assumed that pressure at Albany and then solved the problem for the most economical amount of copper on the line, I should have arrived at an entirely different result from that obtained upon the assumption of 35,350 volts at Niagara. **Wm. A. Anthony.**

Vineland, N. J., June 16, 1894.

ELECTRICITY AND HYDRAULIC GOLD MINING.

Can electricity be employed as an agency to separate from the gravels the free gold carried in suspension in the tail sluices of our hydraulic mines? Has free gold sufficient affinity for it that the gold can be saved? Under our present system the sluices are charged with quicksilver, but the large volume of water *necessary* to disintegrate the gravel in the bank and at the same time to *carry the debris into the restraining dam or basin* takes with it nearly half the gold, which is lost, as we only get what amalgamates with the quicksilver. We want some kind of a plant which can be placed at the end of our tail sluice, and if electricity can do the work before the washed gravel is deposited, or even afterwards, that plant would be equal to owning a quarter of all the hydraulic mines in the State.

Here is a field for an inventive genius and if you cannot give me the desired information, please kindly hand this to some practical scientific person who may take an interest in this subject or give me the names of such persons that I may place the matter before them in a more definite manner. **E. J. Baker.**

North San Juan, Nevada Co., California.

THE
ELECTRICAL ENGINEER.
[INCORPORATED]
PUBLISHED EVERY WEDNESDAY AT
203 Broadway, New York.
Telephone: 3860 Cortlandt. Cable Address: LENGINEER.

Geo. M. Phelps, President. F. R. Colvin, Treas. and Business Manager.

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Philadelphia Representative, 1018 Chestnut Street, }

TERMS OF SUBSCRIPTION, POSTAGE PREPAID.

United States and Canada,	per annum,	$3.00
Four or more Copies, in Clubs (each)	"	2.50
Great Britain and other Foreign Countries within the Postal Union	"	5.00
Single Copies,		.10

[*Entered as second-class matter at the New York, N. Y., Post Office, April 9, 1888.*]

EDITORIAL ANNOUNCEMENTS.

Addresses.—*Business letters should be addressed, and drafts, checks and post-office orders made payable to the order of* The Electrical Engineer. *Communications for the attention of the editors should be addressed,* Editor of The Electrical Engineer, 203 *Broadway, New York City.*

Communications *suitable for our columns will be welcomed from any quarter. Discussions of subjects relating to all branches of electro-technical work, by persons practically acquainted with them, are especially desired. Unavailable and rejected manuscripts will be returned only when accompanied by the necessary postage.*

Advertisements.—*We can entertain no proposition to publish anything for pay, or in consideration of advertising patronage, except in our advertising columns. Our editorial columns will express our own opinions only, and we shall present in other columns only such matter as we consider of interest or value to our readers.*

Vol. XVII. NEW YORK, JUNE 27. 1894. No. 321.

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ELECTRICAL RESONANCE.

IN this week's issue we print an article by Prof. Anthony on "Electrical Resonance as Related to the Transmission of Energy," in which he describes in very clear language, aided by simple mechanical illustrations, the processes involved in the resonant transmission of energy. The simplicity and clearness will be appreciated by many who have followed this subject only in a general way, but certain conclusions at which Prof. Anthony arrives deserve special consideration by those who have followed the subject more closely.

The general drift of Prof. Anthony's arguments is rather to depreciate the advantages gained from resonance and is calculated to cool down somewhat the enthusiasm of exalted minds that have perceived in electrical resonance more than there lies in it in reality. We must only bear in mind that the conditions which most generally obtain in the practical use of electrical devices are usually such as to assign to resonance a comparatively insignificant role. For the sake of illustration, for instance, if we have a highly efficient transformer supplied from an efficient alternating generator, the secondary circuit has but very little chance to perform its own vibration, and in order that it may do so, it would be necessary to diminish very much the mutual inductance between it and the primary. This will hold in general, although there might be conditions under which the secondary current flow may be affected very considerably by resonance, as, for instance, when the secondary is wound for a very high potential. Prof. Anthony's arguments apply more particularly to resonance existing on a long distance transmission line, and he argues that no advantage would be gained by tuning the line to the impressed vibration. While we must admit the truth of Prof. Anthony's remarks in general, it seems to us that inasmuch as in practice one is not at liberty to choose ideal conditions, but has to obtain the best result under the conditions imposed entirely by the circumstances of each case, it may become important to observe the conditions of resonance. In an electrical circuit in which perfect resonance is maintained, the impedance of the conductors is reduced to merely their ohmic resistance; and, therefore, in such cases by a given E. M. F. at the terminals the greatest current may be made to flow through the circuit. This, as Prof. Anthony says, allows us to reduce somewhat the loss in the line. But there are unquestionably disadvantages which may become very great in case resonance is maintained. Of these disadvantages not the least is the great risk incurred of throwing the line out of resonance by a comparatively very small disturbance on the circuit. In fact this alone would suffice to make it, as a rule, very desirable to keep resonance out of the system as much as possible, although, as admitted, there would be some saving in copper; but this saving, as Prof. Anthony points out, is obtained by imposing upon the dielectrics greater stresses.

But while it is only proper to guard against cherishing too sanguine hopes and against expecting from resonance more than it is capable of affording, yet it has had, and it will have, no doubt, valuable uses in the operation of electrical devices. We need only remember the magnificent experiments of Hertz, Lodge and Tesla, in which the observance of the adjustments is essential to the success of the experiments and the results to be obtained; and how important this element may become in the operation of telegraph apparatus, as recently proposed by Dr. Pupin, the future alone can tell.

LEGAL NOTES.

THE GOVERNMENT SUIT TO ANNUL THE BERLINER PATENT.

ARGUMENT in the case of the United States *vs.* American Bell Telephone Co. and Emile Berliner, before Judge Carpenter in Boston was concluded on Wednesday, June 20. Judge Taylor, whose argument for complainants was noted in THE ELECTRICAL ENGINEER of June 20, was followed by J. J. Storrow, Esq., for defendants, who presented the case of the Bell Co. in an elaborate and exhaustive argument, directed to establishing the entire good faith of his clients in respect to all the proceedings and the delays in the Patent Office attending the application and issue of the Berliner patent. He also discussed the technical questions and expert evidence touching the merits of the patent as covering a patentable invention in view of the state of the art of telephony and of the patents long previously issued to Berliner. In respect to the long pendency of the Berliner application, Mr. Storrow said the Bell company had been continually urgent for action by the Patent Office officials. Examiners had so testified; Mr. Lyons had said that the Bell Co.'s counsel were " urgent and persistent beyond toleration."

For some years the application was entangled in interferences, in which it ought not, in justice, to have been involved, and against which the Bell Co. and Berliner vigorously protested. Obnoxious rules existed in the Patent Office, the most obstructive of which were eventually repealed, chiefly in consequence of exertions made by Berliner and the telephone company. The closing argument for the Government was made by Causten Brown, Esq., who forcibly supplemented the long argument of Judge Taylor in opening the case. The case was then given to the Court.

INCANDESCENT LAMP LITIGATION.—In the suit of the Edison Electric Light Company at Chicago against the Chicago Incandescent Lamp Company, the Empire Electric Company and the Coöperative Electric Light Company, for using certain alleged infringements of the Edison Lamp patent, Judge Grosscup issued a preliminary injunction restraining the defendants from making or selling the lamps complained of until a final decision by the courts. In Brooklyn Judge Benedict has allowed a similar injunction to issue to the local Edison Company.

SOCIETY AND CLUB NOTES.

THE NEW YORK ELECTRICAL SOCIETY VISITS THE POSTAL BUILDING.

One of the principal aims of the New York Electrical Society is not only to keep abreast of the times by giving lectures or papers which embody the latest developments in electrical theories, but to afford its members an opportunity, from time to time, of seeing the practical side of electrical progress in its most advanced and most approved form. A very successful season was fittingly brought to a close on Tuesday, the 19th inst., by a visit, on the invitation of the Postal Telegraph-Cable Company and the Commercial Cable Company, to the new Postal Building, at Murray St. and Broadway.

The visitors, to the number of 180, among whom were many ladies, assembled in the large room on the second floor, where, at 8 o'clock the annual meeting of the Society was held. According to the Treasurer's report, the finances are in a healthy condition, there being $107 in the treasury, and the Secretary's report showed a net increase for the season of 40 members—43 having been elected, and three struck off the rolls for non-payment of dues—and a total membership of 350.

The election of officers resulted as follows: *President*, C. O. Mailloux; *Vice-presidents*, Dr. William J. Morton, Dr. Michael I. Pupin, Luther Stieringer, F. A. Pickernell, W. S. Barstow, and C. S. Bradley. *Treasurer*, Henry A. Sinclair; *Secretary*, George H. Guy. An interesting feature of the meeting was the presentation of the works of Clerk Maxwell and Sir W. Siemens as a testimonial to Mr. Joseph Wetzler, the retiring president, who had filled various offices without intermission for the past seven years. The books, which were presented on behalf of the members of the Society by Dr. C. E. Emery, bore a suitable inscription.

MR. WETZLER, in briefly thanking the members of the Society for this evidence of their appreciation, said, although he was now retiring to the ranks his interest in the work of the Society would remain unabated, and he should always hold himself ready to contribute in any way in his power to its advancement and prosperity.

MR. C. O. MAILLOUX, the president-elect, in congratulating the Society on the satisfactory showing on the face of the reports of the treasurer and secretary, took occasion to acknowledge the debt of gratitude which the Society owes to Columbia College for its valuable assistance and support, and proposed that Dr. Seth Low, the president of Columbia College, be made an honorary member of the Society. The proposal was loudly applauded and was carried unanimously.

The visitors were then taken by the electric elevators to the Hardware Club, at the top of the building, which had been courteously thrown open to them for the evening, after which, escorted by Messrs. Jones, Davis and Usher, of the Postal Company, and Messrs. Platt and Cuttriss, of the Commercial Cable Company, they were conducted to the operating room on the twelfth floor, and thence through the building to the basement, where the dynamotors for telegraph circuits, the electric elevator and light and power plants were inspected with great interest.

"DECORATION DAY" FOR THE NEW YORK ELECTRIC CLUB.

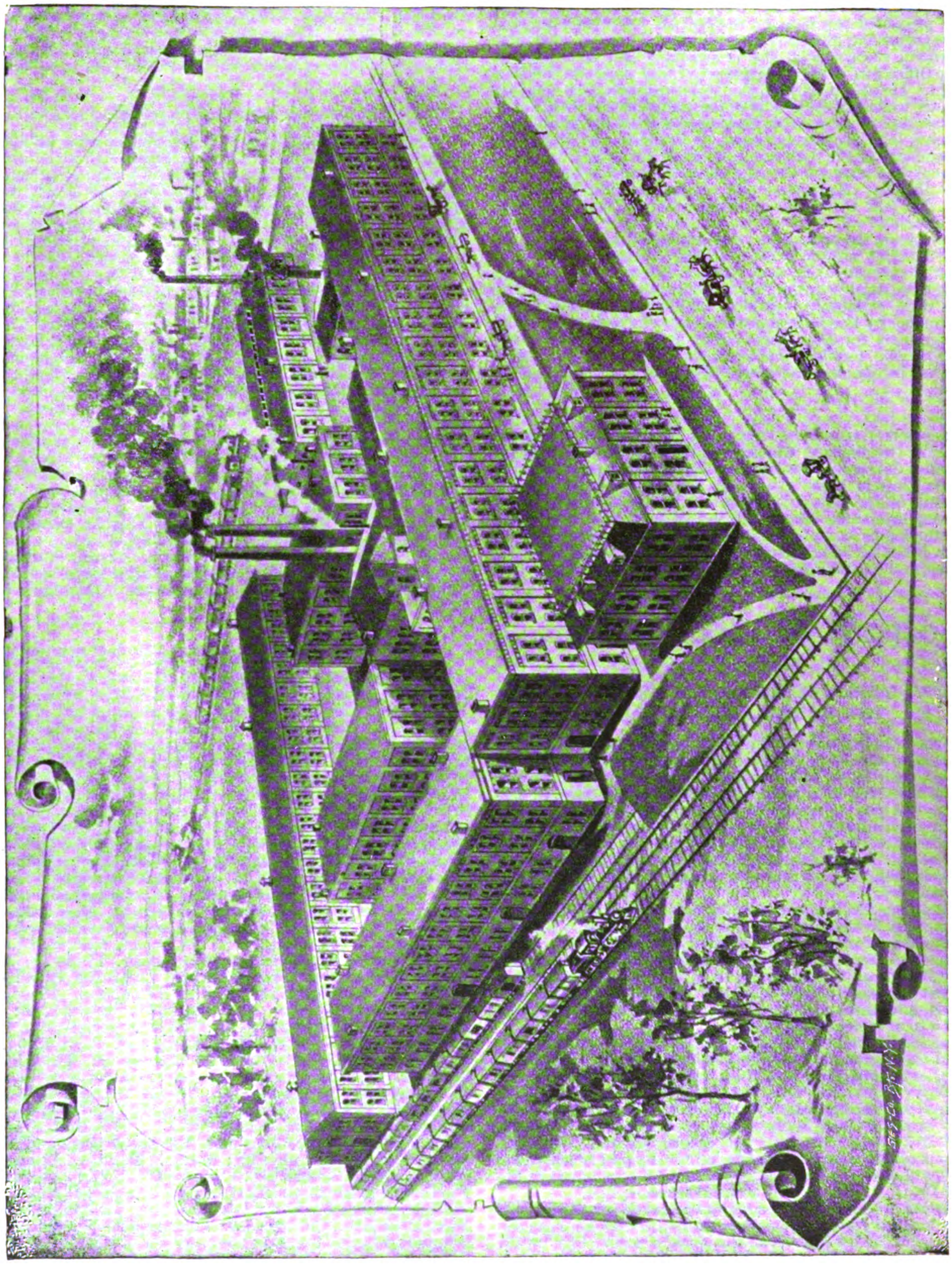
IN accordance with a recent announcement, a number of the former members of the New York Electric Club, celebrated the existence of that well meaning but departed organization, by a dinner on Thursday, June 21, at the Imperial Hotel. Somehow or other, electricians seem to need a rendezvous in New York, and the Imperial has certainly become just such a rallying point of late, thanks to the special courtesies and privileges extended by Mr. Stafford, one of the proprietors. About 40 covers were laid in a large private dining room, and the gathering was presided over most admirably by Mr. H. Ward Leonard, who later requested Mr. T. C. Martin to officiate as toastmaster. Speeches, all in happy vein, were made by Messrs. C. O. Baker, Jr.; C. D. Shain; Reece; Geo. Cutter; S. Rosenstamm; R. T. Lozier; C. E. Carpenter; S. L. Coles; W. J. Johnston; B. E. Greene; T. E. Everts; P. H. Alexander; W. J. Cook and H. L. Webb. During the evening and in some of the speeches the idea of a reorganization of the club was discussed, but there was a very evident feeling of opposition to any attempt to revive the Club on the old basis. The general feeling ran strongly in favor of having occasional reunions in the shape of smoking concerts, musicales, receptions, etc., during the winter; and for such purpose Mr. Stafford placed the handsome room then occupied, at the disposal of electrical men, free of charge, as often as they might see fit to occupy it. Mr. Stafford was heartily thanked for his really generous offer, and Mr. Leonard appointed as a committee, Messrs. Bartlett, Shain, Porter, Webb, Martin, Alexander and Everts to study the subject, and see whether steps should not be taken next Fall to carry out a programme of the nature outlined.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At the monthly meeting of the Council of the Institute on June 20, the following 25 associate members were elected:—

Archbold, Wm. K., Westinghouse Electric and Mfg. Co., 620 Atlantic Av., Boston; Blood, John B., Assistant Engineer, Railway Dept. General Electric Co., Schenectady, N. Y.; Bennett, Edwin H Jr., Electrician and Engineer, Diehl & Co., Elizabeth, N. J.; Bliss, George S., Electrical Engineer, Central District and Printing Telegraph Co., Telephone Bldg., Pittsburgh, Pa.; Brady, Frank W., Laboratory Assistant, Purdue University, Lafayette, Ind.; Caldwell, Francis C., Assistant Professor of Electrical Engineering, Ohio State University, Columbus O.; Chesney, C. C., Electrician, Stanley Laboratory, Pittsfield, Mass.; Childs, Arthur Edwards, *B. Sc.*, *M. E.*, *E. E.*, Electrical Engineer, Westinghouse Elec. and Mfg. Co., Philadelphia, Pa.; Criggal, John E., Electrician, Davis Electrical Works, Springfield, Mass.; Croxton, A. L., Electrical Engineer, Standard Electric Co., Midwinter Fair, San Francisco, Cal.; Eddy, H. C., Salesman, Western Electric Co., 227 So. Clinton St., Chicago, Ill.; Gossler, Philip G., Assistant Electrical Engineer, United Electric Light and Power Co., 107 Montague St., Brooklyn, N. Y.; Hutchinson, Frederick L., Westinghouse Electric and Mfg. Co., Newark, N. J.; 355 Morris Ave., Elizabeth, N. J.; Harris, George H., Superintendent, Electric Car Shops, Birmingham, Ala.; Knox, Frank H., J. G. White & Co., 2116 N. Charles St., Baltimore, Md.; Lilley, L. G., Electrical Inspector, Underwriters' Association of Cincinnati, Wyoming, O.; Lloyd, Herbert, The Electric Storage Battery Co., Drexel Building, Philadelphia, Pa.; Malia, James P., Electrician, Armour & Co., 5314 Union Ave., Chicago, Ill.; Mayrhofer, Jos. Carl, Electrical Engineer, 165 West 82d Street, New York City; Oudin, Maurice, Electrical Engineer, General Electric Co., Schenectady, N. Y.; Plumb, Charles, The Chas. Plumb Electrical Works, 89 Erie Street, Buffalo, N. Y.; Scheible, Albert, Secretary and Assistant, with Geo. Cutter, 486 North Park Ave., Chicago, Ill.; Stearns, Joel W., Jr., Treasurer, Mountain Electric Co., Box 1545, Denver, Col.; Stephens, George, General Superintendent, Canadian General Electric Co., Ltd., Peterboro, Ont.; Winand, Paul A. N., Engineer and Superintendent, Schleicher, Schumm & Co., 3200 Arch St., Philadelphia, Pa.

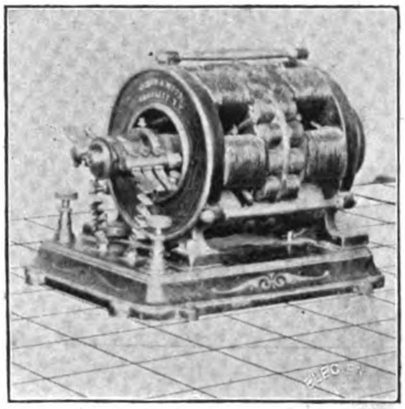
The next meeting of Council will be held September 19th; thirty applications for membership are now on hand for consideration on that date.



FACTORY OF THE FORT WAYNE ELECTRIC CORPORATION, FORT WAYNE, IND.

THE FACTORY AND APPARATUS OF THE FORT WAYNE ELECTRIC CORPORATION.

I.



First Wood Dynamo.

PROMINENT among the companies which have contributed to the growth of electrical work and applications in America is the Fort Wayne Electric Company, recently leased to the Fort Wayne Electric Corporation; and the late startling developments in the change of organization, recorded recently in THE ELECTRICAL ENGINEER, may make a short account of the history of the Company more than usually interesting, as well as timely.

It was in November, 1881, that Messrs. Oscar A. Simons, H. G. Olds, C. L. Olds, R. T. McDonald and P. A. Randall, organized the Fort Wayne Jenney Electric Light Company, for the purpose of manufacturing electric lighting apparatus under the Langley patents. In the Spring of 1882, the Company purchased the Jenney patents and on October 2, 1882, began to manufacture thereunder. In the Fall of 1883, the Company moved to a four story building on East Columbia street, Fort Wayne, employing at that time about sixty hands, but in less than three years found themselves so cramped for room that in 1886, the Company purchased the Gause Mower Works, the present site of the factory. Large additions were immediately made, and employment was given to about two hundred people.

In 1887 the company obtained control of the patents of M. M. M. Slattery and began the manufacture of alternating incandescent apparatus.

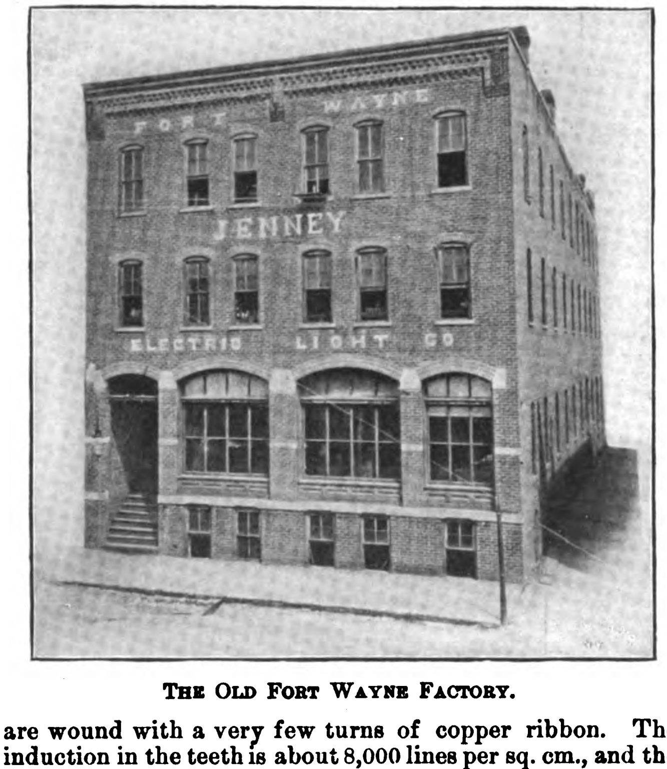
In the Fall of 1888, the works at Fort Wayne were destroyed by fire and the Company were given temporary quarters at the factory of the Kerr Murray Manufacturing Company until July, 1889, when they removed to the new factory buildings, which had been erected in the meantime. In August, 1889, the Fort Wayne Electric Co., as then called, opened a factory at Brooklyn, N. Y., for the manufacture of the Wood arc lighting system. In 1890, the Brooklyn factory was removed to Fort Wayne, and consolidated with the parent plant, and in 1892, the Company built extensive additions to their works to accomodate the large increase in their arc business. On January 3, 1893, a portion of the factory was again destroyed by fire, but repairs were immediately made and facilities for manufacturing increased. During 1892, the manufacture of the Wood alternating system was begun together with that of power generators and motors.

II.

With this brief history of the corporation as an introduction, we come to the description of the works as they now stand. Situated directly on the line of the Pittsburgh, Fort Wayne & Chicago Railroad, the works constitute an aggregation of twelve buildings. The three principal buildings—the Main Shop, the East Shop and the Office Building—are of brick, the two former being each three stories in height. Besides enjoying the advantages of direct transportation facilities for the manufactured product, the works are also supplied with natural gas, which is used under the boilers and throughout the establishment for all heating purposes. The warehouse and store-room, having railroad sidings on two sides, is 300 feet long by 50 feet wide.

Entering upon the ground floor of the Main Shop, we find a collection of machine tools, capable of handling anything up to a 500-kilowatt machine. Here are constructed and assembled all the incandescent, alternating and continuous current power generators of the Fort Wayne Corporation. The alternating machines range in capacity from 37.5 to 300 KW. and our illustration on page 555 gives a view of the latest 6,000 light Wood machine of this type. In the alternators the entire magnetic frame is cast, the pole pieces being slotted near their tips to prevent the generation of Foucault currents, the slots being cast and not milled. These pole pieces have slipped over them a compound coil of copper wire which is composed of four layers of comparatively small wire connected in series with the exciting dynamo, and over these, two layers of heavy wire through which the rectified portion of the main circuit passes, as shown diagrammatically on page 556. By this method compensation or over-compounding for any line loss is made good, automatically and instantaneously.

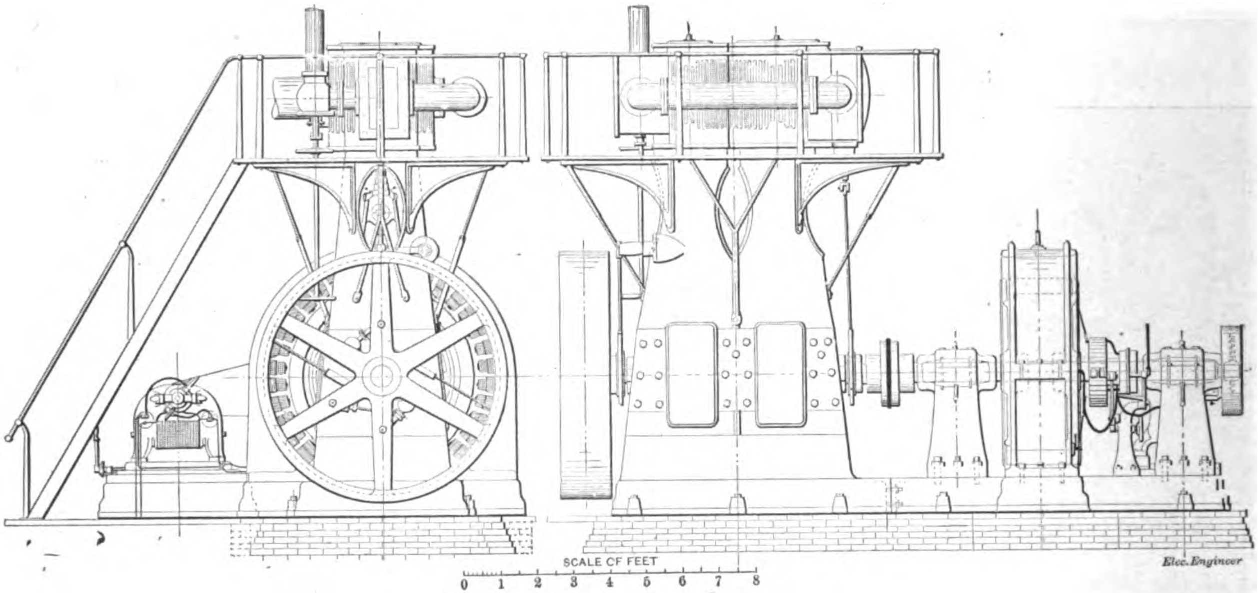
The armature of this alternator is made up of C-shaped stampings ; it is of the iron clad type, the teeth of which are wound with a very few turns of copper ribbon. The induction in the teeth is about 8,000 lines per sq. cm., and the length of the conductor on the armature is 3.6 inches per volt. The electrical efficiency of the machine is 95 per cent. The initial excitation is produced by a small exciter driven from a pulley on the end of the main armature shaft.



THE OLD FORT WAYNE FACTORY.

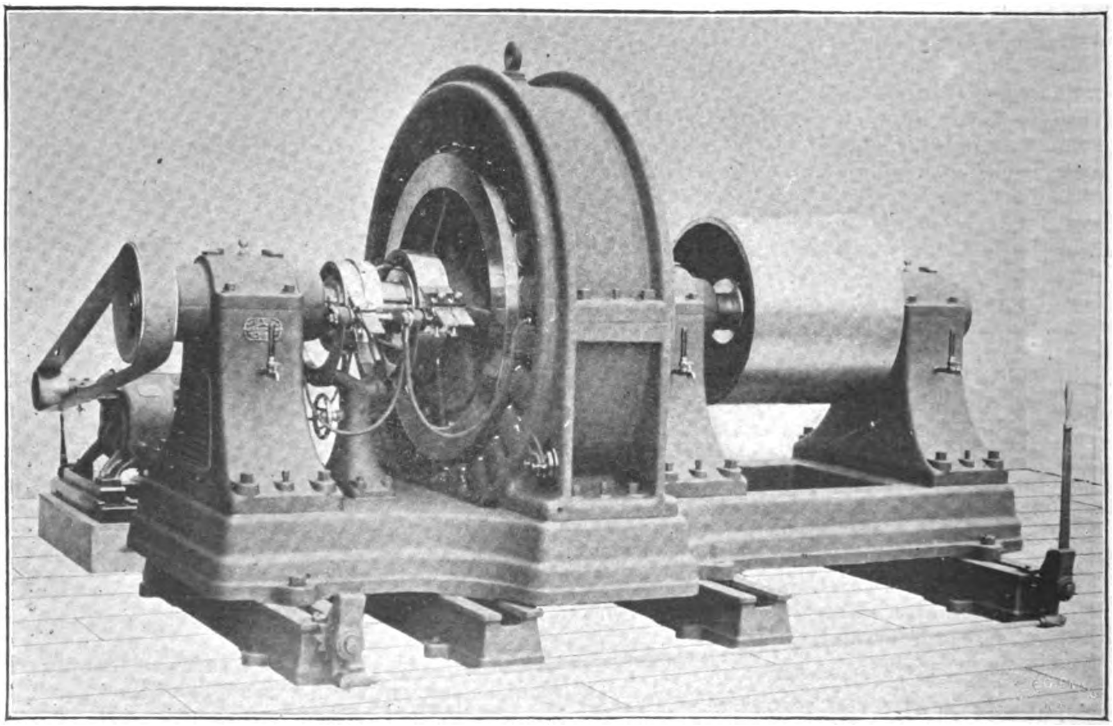
The new Wood 160 K. W. compound alternator and exciter, coupled to a 300 H. P. vertical cross compound engine built by the Ball Engine Co., of Erie, Pa., and running at 240 revolutions per minute, is shown on page 554.

The constant potential dynamos, the general type of which is shown on page 556, are wound for 110, 220 and 500 volts. The construction of the field is in the form of the letter "C," or single coil variety. The core is a wrought-iron forging and the pole pieces are of cast iron, making a very short and low resistance magnetic circuit, requiring from 1.5 to 2 per cent. for excitation.



Wood 160 kw. Compound Alternator, Direct Connected to Ball Vertical Cross Compound Engine.

The armature is a modified Siemens drum, wound either smooth or toothed as desired. The bearings are self-oiling and self-aligning, and the brushes are either copper, carbon or a combination, as conditions demand.

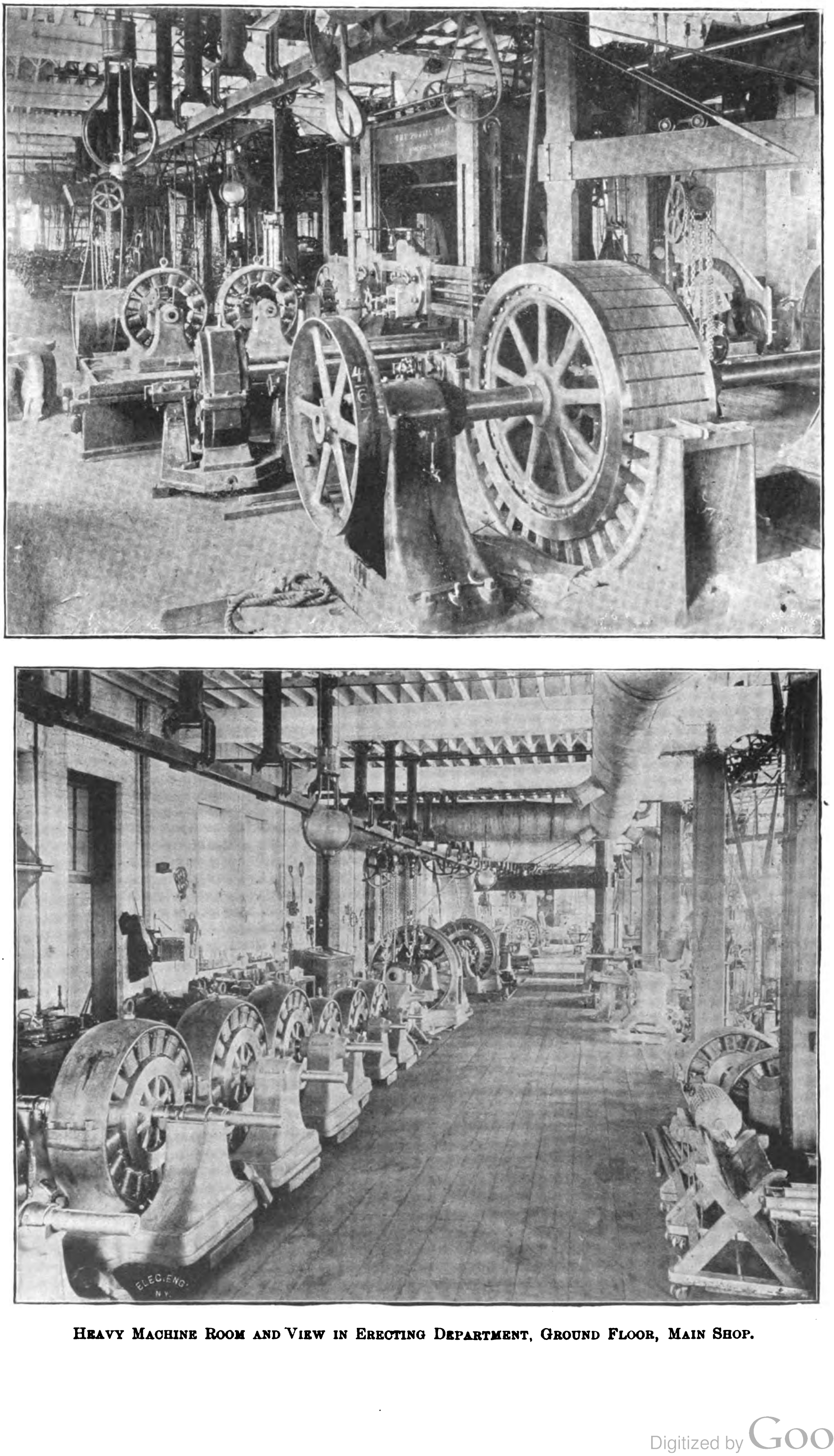


Wood 160 kw. Compound Alternator with Exciter.

One end of this floor is devoted to the stamping of all the enormous quantities of sheet iron used in the construction of armatures and converters, and which is annealed in a special furnace. Right off the centre of this floor is the testing room, in which the alternators and continuous current, constant potential generators are tested. This room is also equipped with a separate engine, so that testing can be carried on for periods after the main factory engine has shut down.

III.

The ground floor of the East shop is devoted entirely to the construction of the Wood arc machines, the work here carried on, consisting in the planing and boring of the side frames and field magnets and the assembling of the machines preparatory to testing, which is carried out in a room adapted for that purpose. Mr. Wood, always alive



Heavy Machine Room and View in Erecting Department, Ground Floor, Main Shop.

to the applications of electricity, has introduced a very expeditious method of cleaning up the brass castings, such as the spiders of the arc armatures. For this purpose, as shown in the illustration on this page, an electric motor drives a rose bit by means of flexible shafting, which the workman passes over the surface, and by means of which the casting can be cleaned up even into its innermost recesses with ease and dispatch.

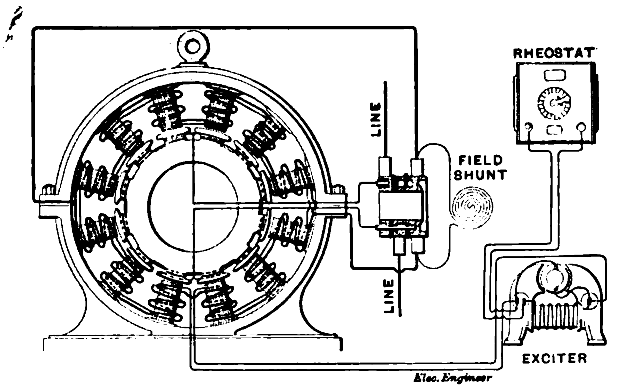
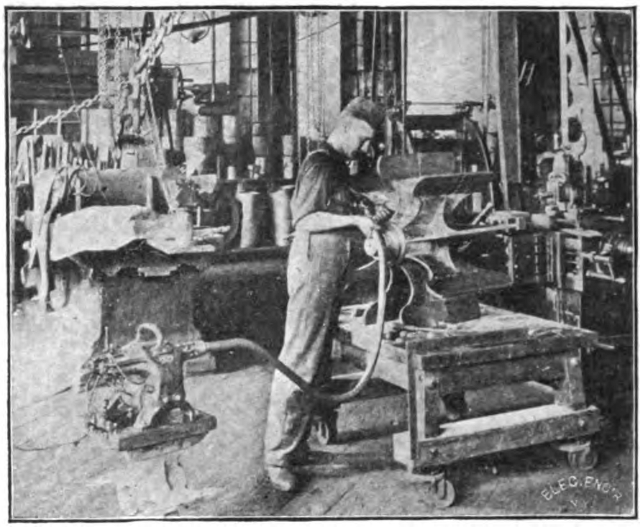


Diagram of Wood Compound Alternator. (*See page* 558).

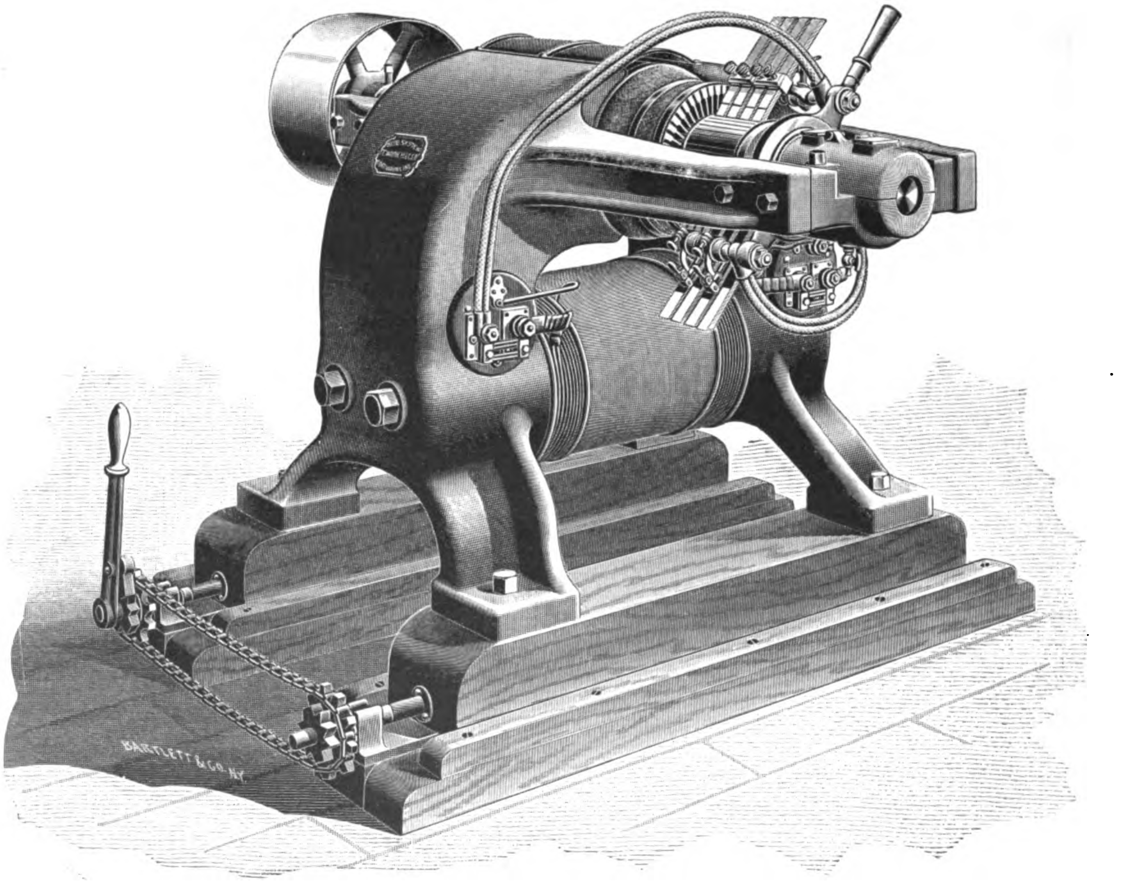
In a corner of this room, also, the insulation of the commutators of the continuous current machines is tested in a novel way. Instead of applying a direct high potential a small series-wound machine with a Siemens armature is employed, giving normally about 200 volts potential. The terminals of the machine are connected by wires with two consecutive bars of the commutator and the machine is then short-circuited at a point directly above an air blast outlet. Upon the separating of the conductors again and opening the short circuit, the air blast blows out the arc, and the high self-inductive discharge of the machine, exceeding 1,000 volts, is thrown into the commutator bars and thus serves to test them to that potential. The process is a very rapid one and the results have shown it to be adequate in every respect.

IV.

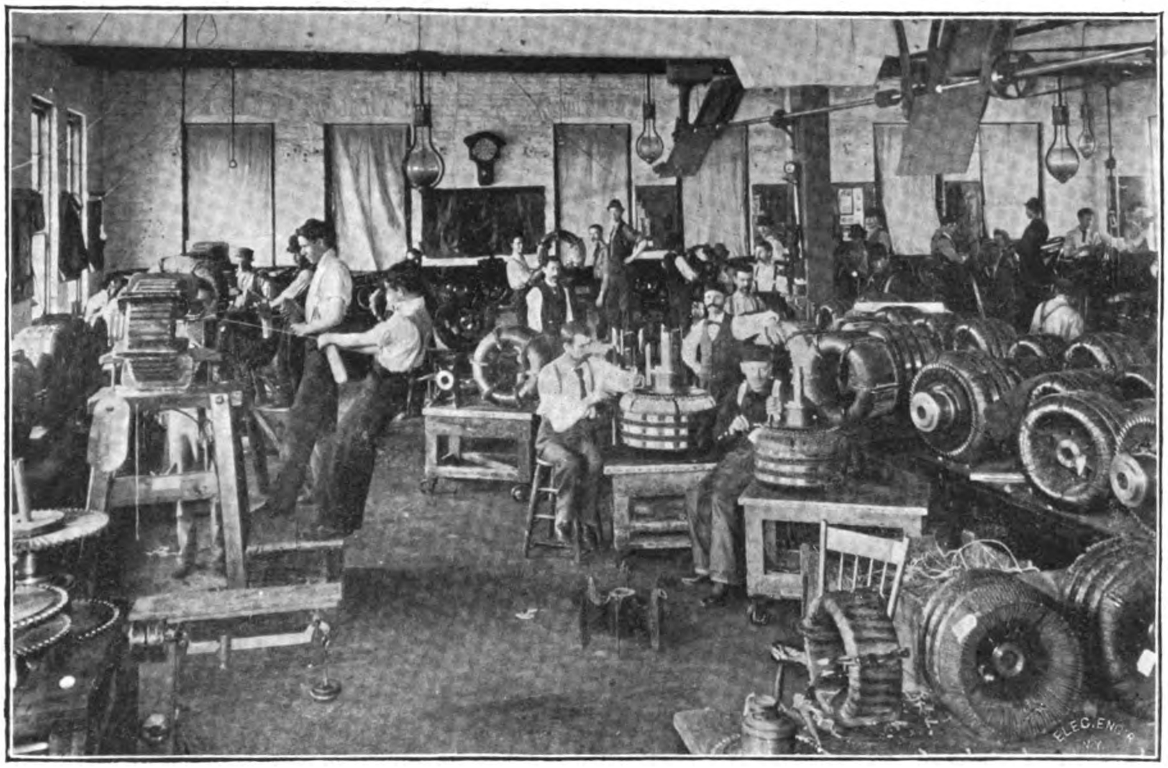
The second floor of the East shop is devoted to the construction of armatures for direct and alternating current incandescent machines. For the direct current incandescent machines a flat twin wire is employed, and each layer of conductors is insulated from the next by a winding of


ELEC. ENG'R. N.Y.

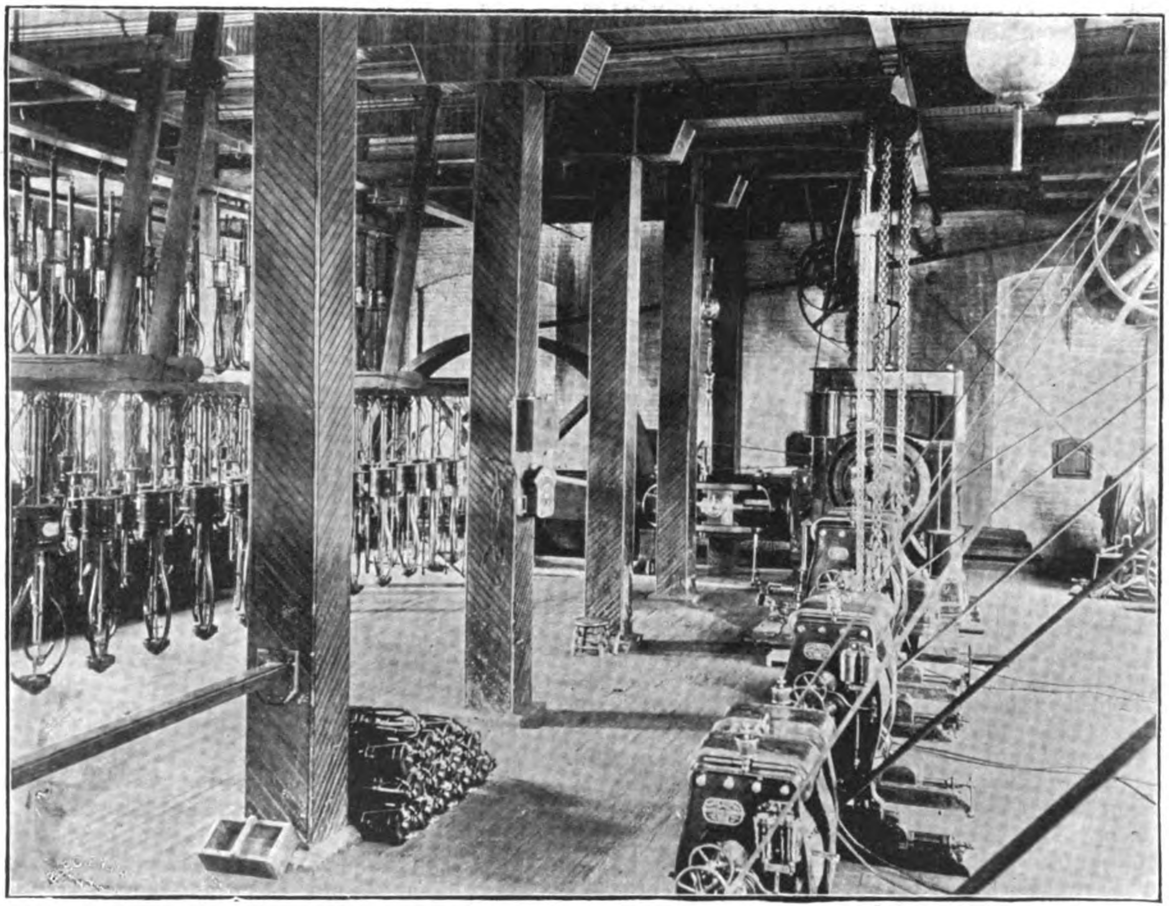
Cleaning a Casting by Electric Motor.


BARTLETT & CO. NY.

Fort Wayne Constant Potential Dynamo.


ELEC. ENG'R N.Y.

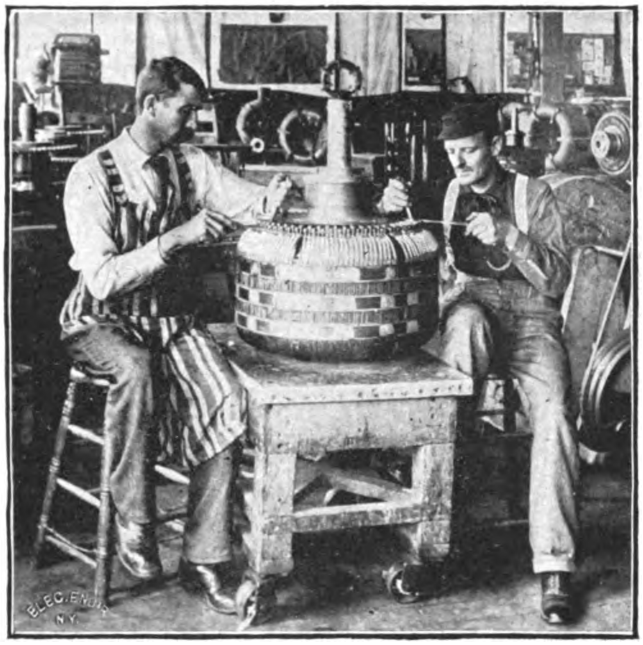
WINDING WOOD ARC ARMATURES, SECOND FLOOR, EAST SHOP.



ARC DYNAMO AND LAMP TESTING DEPARTMENT.

Irish flax thread, an eighth of an inch being left between the turns of the thread. This affords a cushion for the superimposed layer of wire, adds to the insulation and more particularly affords a means of ventilation, as the air has free play between the spacing of the flax thread.

All machines of the same capacity in watts are wound with the same size of this duplex wire and vary only in the grouping of the conductors in series or multiple, or combinations of these two. Thus, for instance the 110 volt machine is wound with four layers in multiple constituting one effective turn; the 220 volt machine in four layers constituting two effective turns; and the 500 volt machine four layers in series, constituting four turns. The armatures of the alternating machines are all wound with the same size of flat ribbon conductor $\frac{3}{8}$ inch wide by .035 inch thick. By thus keeping the sizes of wires on all the armatures uniform, much confusion and error is avoided, while on the other hand it obviates the necessity of maintaining in stock continuously a large number of various sizes of wire much of which would but very rarely be called for.



ARMATURE WINDING.

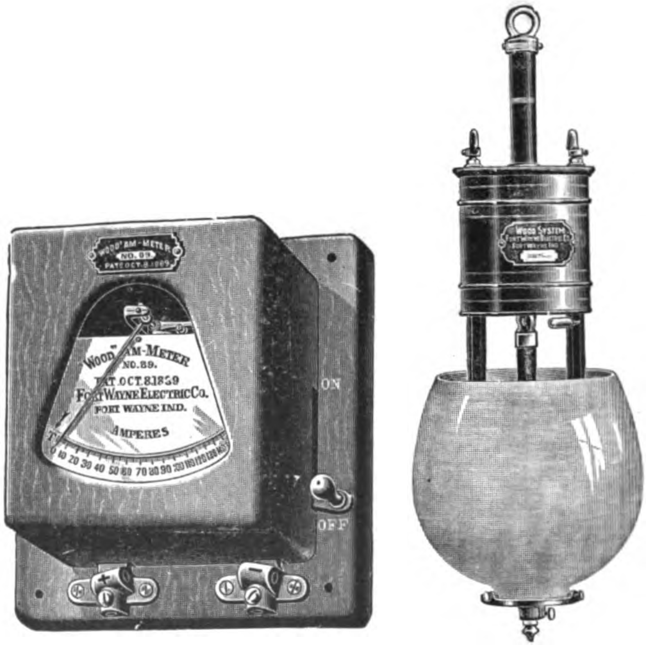
The further half of this shop is devoted exclusively to the winding of arc light armatures, a view of which is given on page 557. For the winding of these armatures Mr. Wood has devised a very ingenious system by which the winding of the coil is begun at the centre and proceeds outwardly, both ends being wound at the same time. By this means the difference of potential between consecutive turns is maintained at the lowest possible limit and is only equal to the difference of potential in one turn; this method of winding also permits of better insulation than is possible where the coil is wound continuously from one end. The iron core consists of a ring wound from No. 10 iron wire which is specially annealed in annealing furnaces. Special hard drawn brass wire is used for binding on the periphery of the armature.

One of the most fruitful sources of trouble in armatures is the breaking of the short connection leading from the armature coil to the commutator, usually forming a fragile web which is easily snapped by the lightest touch when the machine is running. In order to make these short lengths of wires as strong as possible, independently of the size of wire of which the coil is wound, the following method is employed. If the armature wire, for instance, is No. 13 wire, it is cut off a little over half an inch beyond the point where it emerges from the end of the ring under the binding wire. A length of No. 9 copper wire, which has been previously drilled at one end for one-half inch with a No. 13 drill, is then slipped over the protruding end of the armature coil like a cap and soldered. The other end of this stout No. 9 wire is then connected to the commutator. This connection is made by means of a screw, and in order to insure a good contact the wires are first pressed against the commutator spoke by means of a screw vise, after which a screwdriver is applied to the screw. This process evidently relieves the screw and prevents the frequent stripping of the heads as the result of application of too much force in order to bring about good contact.

V.

Another flight of stairs brings us to the department devoted entirely to the manufacture of arc lamps, wattmeters, ampere meters and voltmeters, views of which are shown on page 560. In the excellence of its equipment and systematic methods here employed this department of the works has probably no superior anywhere. It goes without saying that all parts are made to gauges and jigs, thus insuring uniformity and interchangeability.

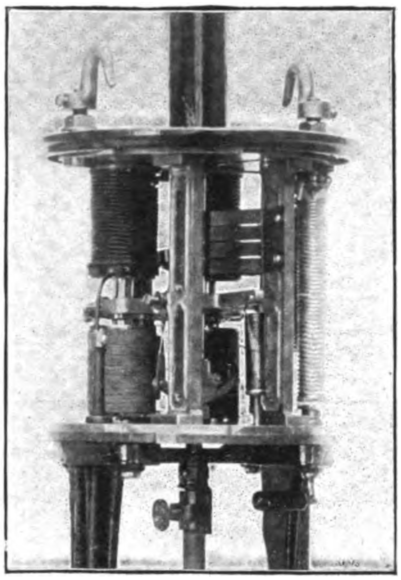
The chief characteristic of the Wood lamp is its simplicity and fewness of parts, as shown in the engraving, page 559. Its continuous operation is insured by three cut-outs, two of which are automatic, and one operated by hand when trimming the lamp. In this way all possible opening of the circuit is avoided. The lamp is regulated by series and shunt coils. The mounting of these coils, a small detail in itself, will serve to indicate the care bestowed on even the smallest part of the company's apparatus. Thus, in order to insure thorough insulation, the lamp coils are wound on brass spools made as follows: A wrought brass head is soldered to the end of a tube, the free end of which is screw-threaded to receive the threaded washer forming the other flange of the spool. Before screwing on this second flange, however, the insulating discs of press board are slipped on the spool and thus remain intact, requiring no slit to be made in them, as would otherwise be the case. The winding of the arc lamp spools is also done in a clever way. Instead of trusting to the deftness of the winder's hand to guide the wire, the latter is automatically guided back and forth by being pressed against a pair of screws placed directly in front of the spool being wound. The screws revolve in opposite directions and as their pitch is exactly equal to the desired



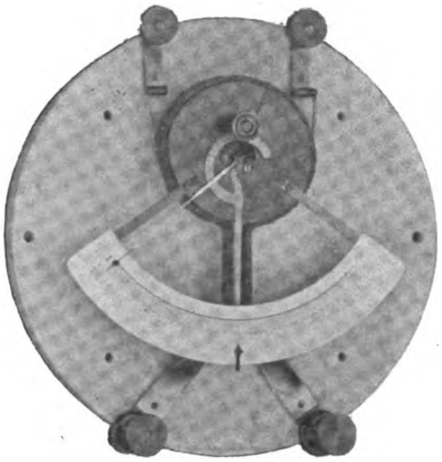
WOOD AMMETER AND ARC LAMP.

lay of the wire, the spool can be wound uniformly at a high speed, with accuracy.

The third floor of the east shop is equipped with a full complement of tools and machines for the manufacture of that miscellaneous auxiliary apparatus which goes to complete the outfit of a central station, such as rheostats, ground detectors, station transformers, switches, etc. These instruments are all mounted on marble bases, the wires being led in from the rear into special thimbles, so that no screws are required The switches are so constructed that the spring which effects the rapid break also insures a rapid closure of the circuit, while at the same time it holds the lever clear of the contact clips when the switch is open. Another part of this floor is devoted to the finishing of brass patterns for switches, single and double pole fuse boxes, arc cut-outs, switchboard arc plugs, and a variety of similar work.



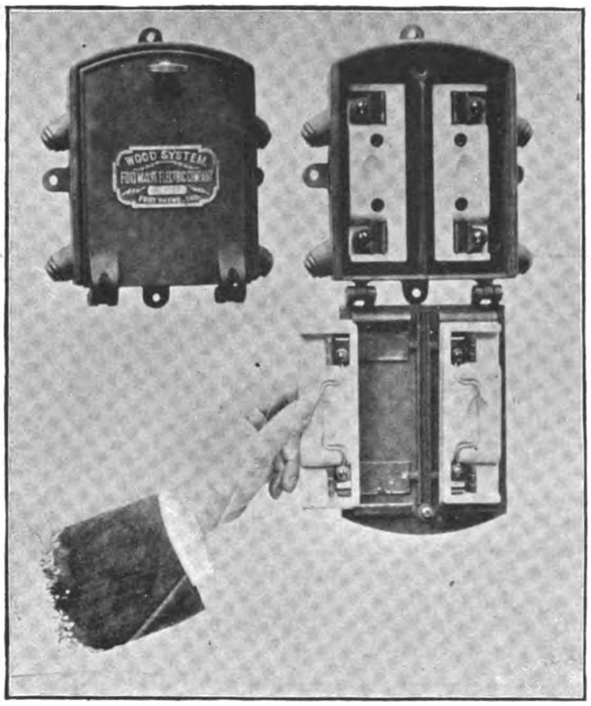
Wood Arc Lamp Mechanism.



Wood Compensating Voltmeter.

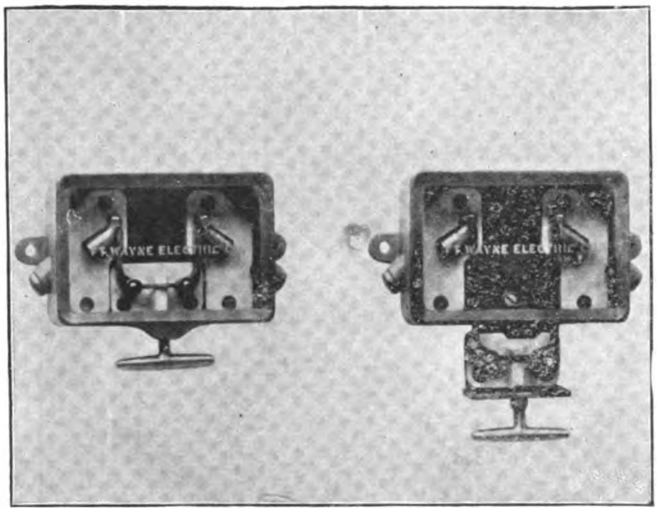
The Wood double pole primary fuse box shown on this page is designed with special reference to safety for the lineman and ease in inspecting and replacing a burnt-out fuse. As will be seen, the fuses are mounted on the cover in porcelain blocks and in such a way that they can be readily slid out for renewal. The very act of opening the cover breaks the circuit on both sides of the line, so that there is no danger of shock from a possible ground.

The porcelain fuse blocks, as will be noted, are hollowed out at the middle point of the fuse and the object of this air chamber is to cause the fuse to blow at that point, owing to the porcelain keeping the fuse cooler in its contact at the ends on either side of the air chamber, than in the free central part. By blowing at the centre the contact terminals are preserved intact.



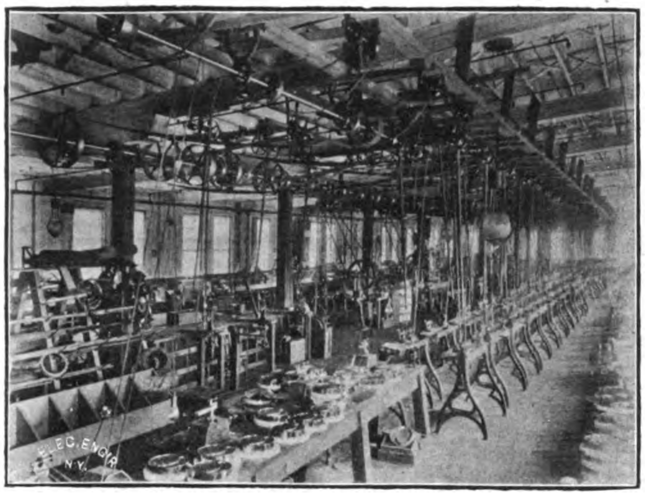
Wood Double Pole Primary Fuse Box.

Special provision has also been made to secure good contact between the fuse and the line terminal, and this is accomplished by stiff springs placed under the clamping nuts in the switch-box. It will also be noted that arcing across from one side of the line to the other is prevented by a rib in the box between the fuse blocks, which fits into a corresponding groove on the cover.



Primary Branch Single Pole Fuse Box.

The Wood primary branch single-pole fuse-box and the manner of withdrawing the fuse block for renewal are shown on this page, the contacts being made automatically.



Arc Lamp Department.

VI.

The wing on the ground floor devoted to the testing of arc dynamos and arc lamps is specially arranged for the purpose, and presents, probably, as well arranged a plant of this nature as can be found anywhere. Power for testing is derived from an engine of 250 H. P., belted to overhead counter-shafting, from which power is taken by belt to the machines to be tested. While visiting the works, the writer had occasion to witness the test of the new Wood 125-light 2,000 C. P. arc machine, which was described in our last issue, and of which an illustration is given on page 563. This machine is so arranged that either pedestal can be slid out and the armature taken out and put back ready to run in 15 minutes; and all this without breaking a single electrical connection. The wires connecting the field coils are of $\frac{3}{8}$ inch round brass rod, covered with hard rubber tubing to $\frac{1}{2}$ inch when finished. This connecting link also acts as a handle for the support of the attendant while inspecting the machine. None of the wires at the coil ends is directly connected to any other wire. At these points neat copper connectors are made which are soldered into the wire and are in turn secured to neat binding posts on the base and to the ends of the rod. Another particular feature of this machine is that the direction of the current can be reversed within the space of a few minutes without breaking a connection, which is accomplished by reversing the brush holders on the brushholder studs. The wires under the machine are encased in Interior Conduit tubing.

ELEC. ENG'R N.Y.

Assembling Alternating Meters.

During the run of the machine witnessed by the writer 50 lamps were thrown on and off with barely a perceptible spark at the commutator. The machine, in fact, may be justly said to represent one of the greatest advances which has been made in arc light machinery for some time past. The Fort Wayne Corporation build arc machines from 1 up to 125 lights of 2,000 C. P. This testing room is also fitted up with racks for the testing of arc lamps. Among the latter we noticed, besides the standard single and double carbon lamps for indoor and outdoor use, a special short arc lamp, illustrated on page 558, which is designed for the illumination of interior spaces where the ceilings are comparatively low. These lamps are provided with short elliptical, flat carbons, whose life is as long as that of the regular round carbon type.

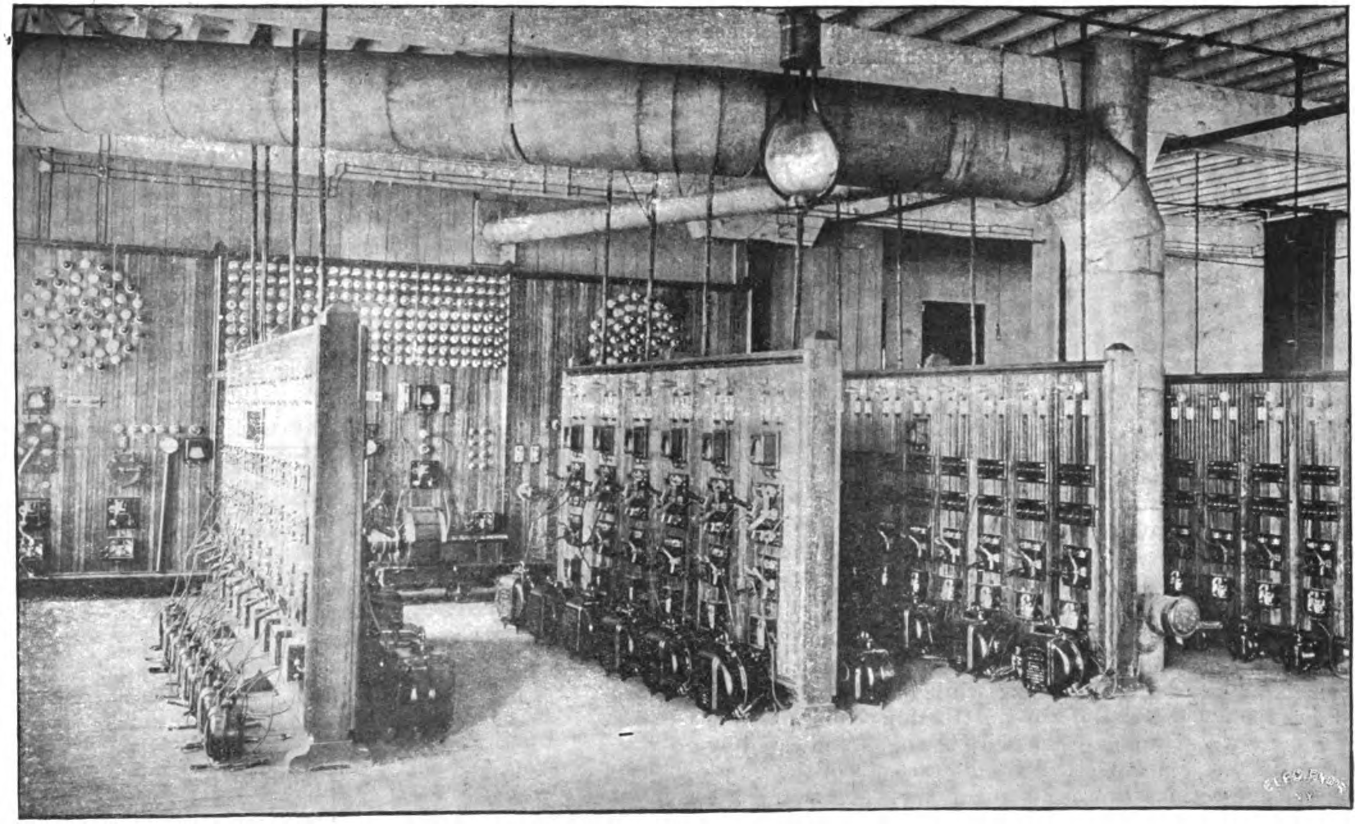
ELEC. ENG'R N.Y.

Stacking Transformer Cores.

VII.

Ascending to the second floor of the main shop we find it devoted to the manufacture of transformers, a new design of which has recently been perfected by Mr. J. J. Wood, the electrician of the company. The transformer complete, and also taken apart showing its interior construction, is illustrated on page 552. The coils, after being wound, insulated with mica and baked, are tested to 5,000 volts alternating between primary and secondary. They are then "stacked," that is, the iron core is inserted. The shape of these cores will be seen in the illustration on page 560. Two of these punchings are placed in juxtaposition, each alternate pair breaking joints; there is, therefore, no greater thickness of iron in the centre of the core than at the outer ends. After the core is in place semicylindrical wooden pegs of maple, boiled in a special compound, are driven in to set up the coil and keep the iron core in place. This method of clamping the iron core does away with the necessity of all bolts, screws or special clamping plates. After the stacking is finished, the coil is again subjected to the 5,000 volt test; if found in good condition it is put in the iron case, the line wires soldered to it, and the case hermetically

VIEW IN TRANSFORMER DEPARTMENT, SECOND FLOOR, MAIN SHOP.

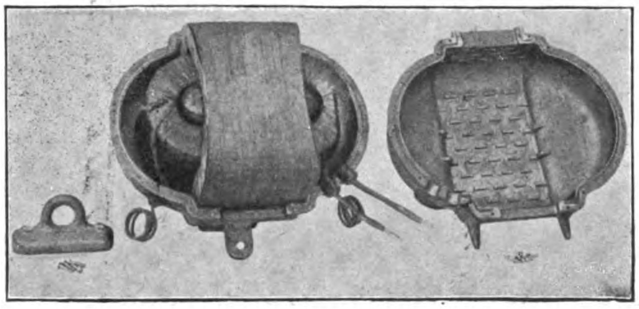


TRANSFORMER TESTING DEPARTMENT, SECOND FLOOR, MAIN SHOP.

sealed. The coils are again tested for contact between primary and secondary, and then for contact between primary and secondary and core and frame. They are then run 10 hours at full load at their normal potential.

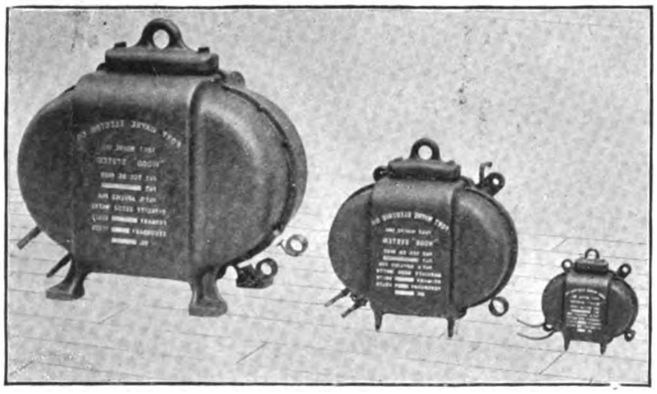
In the new design of transformer Mr. Wood has made special provision for ventilation. As will be seen, the inside of the transformer case is provided with little offsets, against which the transformer core rests and which thus leave an air space between the core and casing. The bottom and top of the case are provided with openings, that at the top being covered by a weatherproof cap. Owing to this construction a continuous stream of air can pass through the transformer without leading to any deterioration of its insulation. It will also be noted that by this construction the case is made part of the magnetic circuit, and, far from seeking to insulate the core from the casing, the coil and the core both are held in place by the case bolts.

Attention has also been given to a small but important detail, that is, the handling of the transformer on pole lines, side walls, etc. In the first place, the transformer case is provided at the top with an eye bolt, by which it can be readily lifted to the desired point. That point being reached, as, for instance, the cross arm of a pole, the transformer can then be immediately lowered to its final position and its suspension maintained by two special swivel suspension hooks. Resting on these hooks the final securing with lag screws can be done at the convenience of the linemen. For temporary work the transformer can be placed in position solely by means of these suspension hooks and be removed in the shortest possible time. The transformers are also provided with feet so that they can be stood up on the floor when desirable.



Wood Transformer, Showing Ventilating Case.

The transformer coils are wound on special machines shown on this page, provided with mechanism in the shape of a counter. This counter is set at the number of turns desired for each coil and when that number has been wound a bell announces the fact to the workman who is thus relieved of all need of that counting and keeping record, which frequently leads to errors; while on the other hand it allows a much more accurate construction than is possible where merely a given length of wire is wound, indicated by a measuring attachment. In winding the coils of the transformer, the sections of the primary and secondary are alternated.



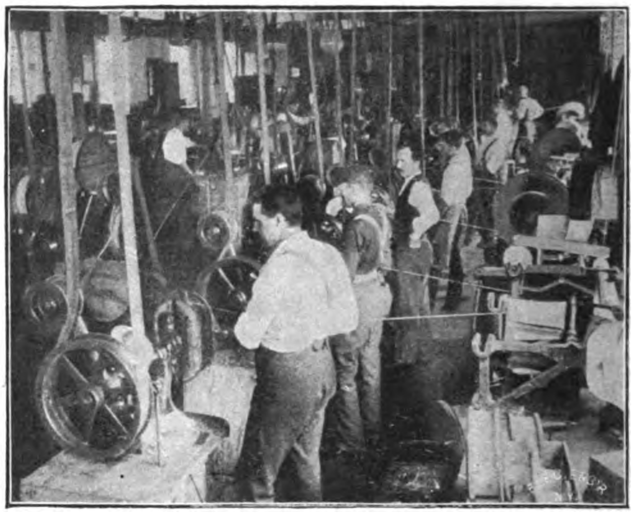
Wood Transformers.

VIII.

At the end of this floor is fitted up an elaborate testing room shown on page 561, where the transformer tests above alluded to are carried out. This room is equipped with a full complement of instruments and also with changing switches which enable the transformers of any voltage to be tested without changing any rheostat connections. Here also are tested the armatures of the alternating machines, 5,000 volts being applied between the core and coils and the same potential between coil and frame. The armature is then connected up, the commutator for the compounding coil put on and the whole again tested to 5,000 volts from winding to core. The farther end of the second floor of the main building is used as a tool room, being equipped with the finest machinery for that purpose.

IX.

Besides the two main shops, the works comprise a number of auxiliary buildings, among which we may first mention the brass foundry, a building 30 x 80 ft., in which all the brass and zinc casting is done, and which also contains the annealing furnaces for treating the iron destined for cores of armatures and transformers.

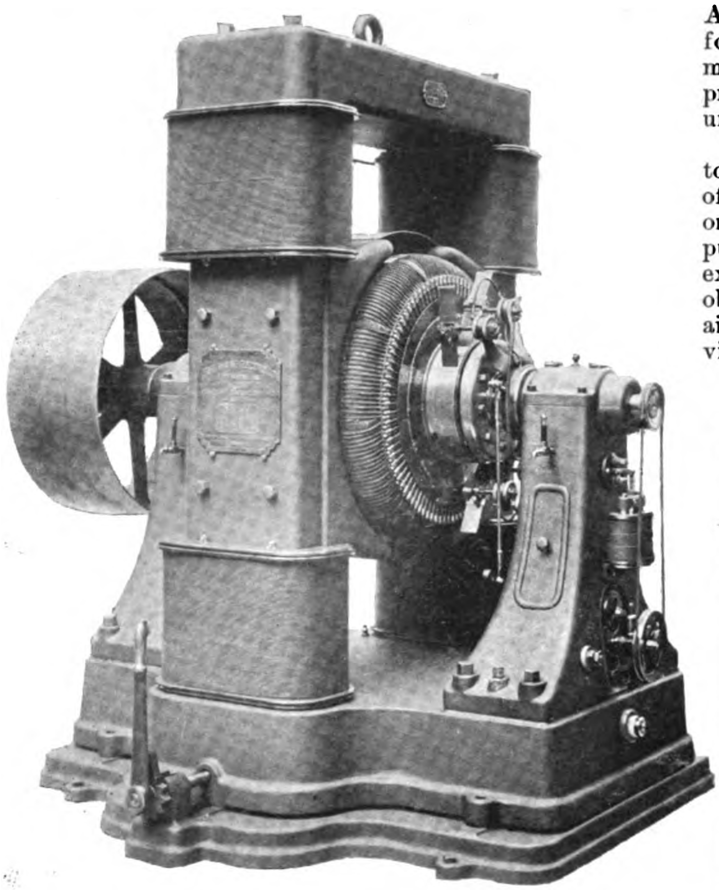


Winding Transformers.

Situated a short distance off the main shop is the laboratory, in which all the electrical indicating instruments are calibrated. Among the latest instruments to be brought out by the Corporation, which the writer saw under test, is a new alternating current wattmeter, which will shortly be placed upon the market, whose recorded indications show absolute proportionality between load and the number of revolutions, beginning with 1¾ amperes, up to full load. Another feature of this instrument is the fact that it can be used for both two and three phase currents, or, indeed, for that matter, for currents of any phase.

In the Brass Foundry.

Another instrument which will be of special interest to managers of alternating current stations is the new Wood



New Wood Arc Dynamo.

compensating voltmeter, a view of which, with the cover removed, is shown on page 559. This instrument is intended to give the indicactions direct of the difference in potential at the distant end of an alternating feeder and thus to do away with compensators heretofore employed for that purpose. The fine coil is, as usual, connected across the circuit at the station; surrounding it is a single turn of heavy copper strip, in series with the line circuit and connected so as to act differentially to the fine wire coil. As the load increases, it tends to weaken the field and thus reduces the reading of the voltmeter and in this manner gives an exact indication of the potential at the distant end. By using a variable low resistance shunt the instrument can be adjusted to any conditions of line loss. As the fine wire is connected directly to the station transformer, no auxiliary transformers are required. The magnetic system of this instrument is on the repulsion principle, and, as will be noted, the scale divisions are very uniform over the entire range.

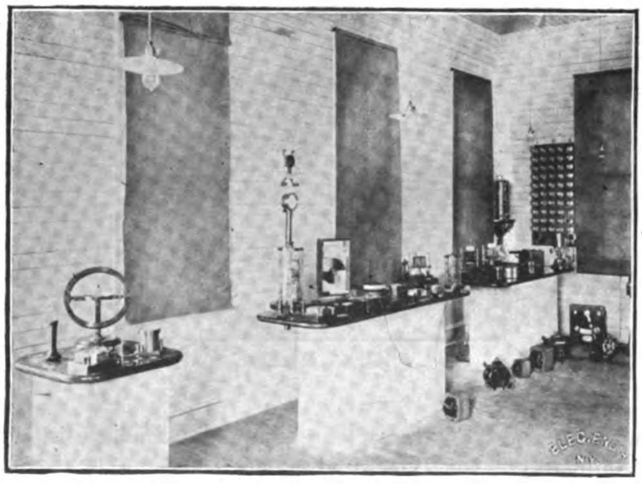
ELEC. ENG'R. N.Y.

In the Drafting Department.

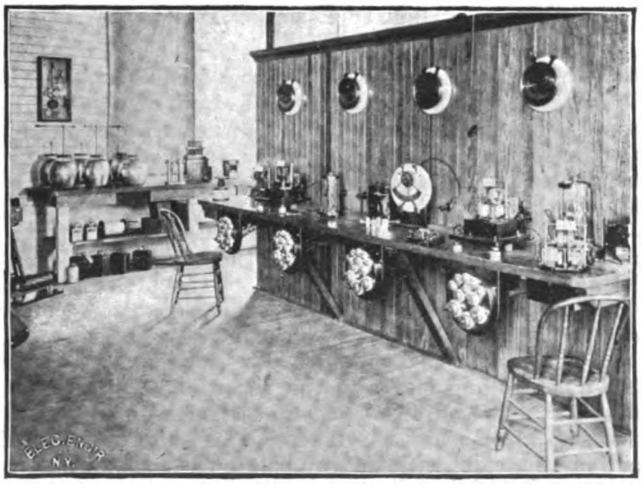
We also observed here an alternating fan motor adapted to be run on circuits of all phases, the armature consisting of a copper cylinder with an iron core as a "diverter." In one corner also, we noticed apparatus constructed for the purpose of repeating some of the Tesla high frequency experiments. We remarked here a simple method for obtaining the air blast for blowing out the spark at the air gap. This consisted of an alternating fan motor provided with a fan having 10 blades, arranged in the manner of an undershot water wheel; with the motor revolving at 2,000 revolutions per minute the 10 blades thus give 20,000 puffs per minute and hence as many breaks at the spark gap.

The electrical equipment of the laboratory is a most excellent one. Besides a complete series of standard resistances, there are here a Weston voltmeter, Lord Kelvin's electric balances, a 500-ampere Siemens dynamometer, a Kelvin electrostatic voltmeter, tangent galvanometers, and a variety of other apparatus of like nature.

The Office Building, connected with the works by a bridge, is a two-story brick structure, 65 x 65 feet, with an attic. The ground floor is occupied by the offices of the Corporation, the book-keepers, etc. The second floor is



View in Calibrating and Testing Laboratory.



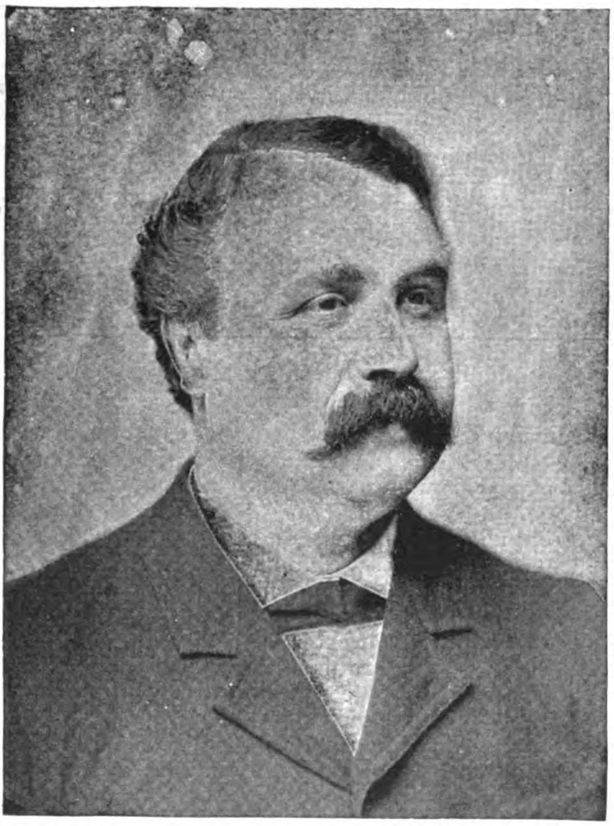
View in Calibrating and Testing Laboratory.

devoted to the draughting rooms of the Engineering Department, the offices of the Engineering Department, the Directors' Room and Legal Department; while the attic above serves as a store-room for drawings and the making of blueprints.

X.

And now a few words of the men who have lent their energies to the creating of the works and the apparatus we have just described.

Mr. Ronald T. McDonald, who from first to last has been active and prominent in the affairs of the Fort Wayne Corporation, is a young man, having been born in 1849. He was born in Allegheny City, Pa., enlisted as a drummer boy in the Civil War, fought as a Union soldier, and then carried his tireless energy into business life. His education had been such only as that afforded by the common schools, but he was alert, intelligent, observant, supplying by native wit any deficiency of booklore. He now became connected with the dry goods trade, and at an early age was a member of the firm of Evans & McDonald, at Fort Wayne, wholesale dealers and jobbers in dry goods. The rapid development of electric lighting arrested his attention, and foreseeing the opportunities of the industry he began the manufacture of arc light apparatus. In 1882, he was one of the incorporators of the old Fort Wayne Jenney Electric Light Co., was at once elected a director, and at the same time assumed the management of the business. From that time down to the present, through all the vicissitudes of the art and all the various commercial and financial combinations that have been seen, Mr. McDonald has remained an active participator in events, and a controlling factor in the situation. Outside a business life that would exhaust the strength of any ordinary man, Mr. McDonald has taken a warm interest in politics, and his share in national campaign as a somewhat independent Republican has more than once attracted attention.


Ronald T. McDonald.

Among the ablest of Mr. McDonald's lieutenants in the management of the Corporation is Mr. C. S. Knight. This gentleman is a "Buckeye" by birth and gained his large business experience during twenty years spent in the service of the Pennsylvania Railroad Company west of Pittsburgh. He left the railroad business to become superintendent of the Fort Wayne Gas Company; after remaining with that company for several years he was induced by Mr. McDonald to cast his lot in with the Fort Wayne Jenney Electric Light Company, in its early days. He has for several years had charge of the sales department, and later, has had general supervision of the sales and manufacturing departments. It is said few business men travel as many miles per year as Mr. Knight, and none is more keenly alive to the wants of customers than he.

C. S. Knight.

Mr. Charles C. Miller was born in Fort Wayne, Indiana, in 1867. He obtained his education in the public schools in Fort Wayne, and in October, 1882, entered the employ of the Fort Wayne Jenney Electric Light Company as office boy, and later on was appointed stenographer and private secretary to Mr. R. T. McDonald, general manager and treasurer of the company, which position he retained upon the formation of the Fort Wayne Electric Company. In 1891 he was appointed purchasing agent of the company and is still employed in that capacity.

C. C. Miller.

Mr. James J. Wood, the electrician and mechanical engineer of the Company was brought up in New York City, and at the age of 11 moved with his parents to Branford, Conn., where he entered the employ of the Branford Lock Company. He remained with this company for seven years, and during this time worked himself up to a position in which he had charge of what were known as "machine locks," such as are now used for safes and on large store doors. In 1874 young Wood left the Branford Lock Company and moved to Brooklyn to learn the machine and tool making business, agreeing to serve an apprenticeship with a manufacturing concern for three years. He soon discovered that in order to succeed he would have to thoroughly understand geometrical and mechanical drawing and in order to become proficient in those studies he attended the Brooklyn High School. After four years constant study he received his diploma and graduated with all the honors of the class as mechanical engineer and draughtsman. During this apprenticeship Mr. Wood, whose mechanical ability had shown itself in the most pronounced way, constructed a great many of the special tools used in making the cables of the Brooklyn Bridge, and while still in the employ of the Brady Manufacturing Co. and during the latter part of 1876 or the early part of 1877 became acquainted with Mr. J. B. Fuller for whom he performed all of his electrical experiments and whom he assisted in the construction of his electrical machinery. During the fall of 1877 they succeeded in operating six lights in series from a Fuller machine and made a public demonstration at No. 11 Greenwich Ave., New York City, which was known as Maltby's Oyster House. This exhibition was without doubt the first exhibition of series arc lighting in this country. In May, 1879, Mr. Wood brought out his first machine. This dynamo illustrated in the vignette at the beginning of this article was of the multipolar pattern and contained what is now known as an iron clad armature. It was a decided improvement over dynamos previously manufactured and was capable of running either one large light of 2,000 c. p. or three smaller lights from three independent circuits. The Fuller Electrical Company with which Mr. Wood was connected, received a medal from the American Institute at the close of the exhibition in the fall of 1880, for this machine.

James J. Wood.

Thomas Duncan.

F. S. Hunting.

A. L. Hadley.

E. A. Barnes.

Mr. Wood also has good reason for believing that he was the first in this country to invent the differential lamp, operating such lamps in Brooklyn, in the fall of 1878 and early in 1879. He continued making inventions and improvements for the Fuller and Fuller-Wood Companies in arc lighting apparatus, until that company sold out to the American Electric Manufacturing Co. in 1885.

Almost the first work Mr. Wood did for this Company after completing the factory was to design the arc lighting machinery for use in the Statue of Liberty in New York Harbor, and the machinery is still in operation In 1888 he severed his connection with the American Company and took charge of the manufacture of electrical apparatus for the Fort Wayne Electric Company. Since his connection with this company he has invented and constructed a complete arc lighting system with all its details including cut-outs, lightning arresters, instruments, etc., and constant current dynamos varying in capacity from 1 to 125 lights, as well as arc lamps for every known purpose, 46,000 of these lamps having been sold during the past four years.

Mr. Wood's latest work has been on alternating current machinery of which he has designed a system of alternators which vary in size from 750 to 6,000 lights capacity. Also a series of transformers varying in size from 300 watts or 6 lights to 25,000 watts or 500 lights. Mr. Wood, is but 38 years old and thus still in the prime of life, and much may yet be expected of him.

Mr. F. S. Hunting, in charge of the engineering department of the works, is a graduate of the Worcester Polytechnic Institute, Worcester, Mass. In October, 1888, he entered the employ of the Fort Wayne Electric Company as draughtsman. After a few months in the draughting room he was made assistant to Mr. Slattery, then electrician for the company. As Mr. Slattery's assistant he had general supervision over all the designing and experimental work of the company, and also assisted in the designing of new transformers and machines. After about a year in this position, Mr. Hunting was made assistant to Mr. Talbor, then chief engineer. A year later Mr. C. S. Bradley began work at Fort Wayne on alternating motors and particularly upon the tri-phase system, and Mr. Hunting was detailed to assist him in this work. While engaged upon this experimental work with the tri-phase system, he made several inventions upon which applications for patents have been made, some of which have been already allowed, covering methods of converting from one phase to another. In September, 1893, he was made chief engineer of the company, which position he still holds. Mr. Hunting is a full member of the American Institute of Electrical Engineers.

Mr. A. L Hadley, assistant electrician to Mr. Wood, graduated with the class of '89 from the Worcester Polytechnic Institute. After a few months experience in the Thomson-Houston Works at Lynn, he entered the employ of the Fort Wayne Company, being put in charge of the transformer testing. Later he was made assistant to Mr. Slattery in storage battery work, having charge of the details of construction and the electrical experiments in connection therewith. After working on this line for about two years, in which time the battery was perfected and a street car equipped and run for six months, Mr. Hadley was associated with Mr. C. S. Bradley on tri-phase work, especially on small motors, until last year when he became connected with the experimental testing with Mr. Hunting. Last November Mr. Hadley was made assistant to Mr. J. J. Wood, having charge of the experimental testing and the designing of winding for special transformers, direct current dynamos, motors, etc.

Mr. Thomas Duncan was born in Girvan, Ayrshire, Scotland in 1865, there attending the public schools until ten years of age, when he removed with his parents to Baronscourt in the North of Ireland, where his father was appointed surveyer and land steward to the Duke of Abercorn, then Lord Lieutenant of Ireland.

After passing through the national schools, he graduated from the Newtownstewart Model Schools and the Intermediate Academy successively, and from Foyle College in 1883.

In the fall of 1884, he came to America, locating in Boston and followed the vocation of a pharmaceutical chemist until 1886, when he entered the electrical profession under the late M. M. M. Slattery in the manufacture of incandescent lamps and alternate current apparatus.

The following year he went to Fort Wayne to take charge of the testing department in the incandescent lamp factory of the Fort Wayne Jenny Electric Light Co.

After the works were destroyed by fire in 1888 he was transferred to the Thomson-Houston Company at Lynn, Mass., there entering the instrument and meter standardizing department, and remaining until the latter part of the following year, when he returned to Fort Wayne to assume a similar position with the Fort Wayne Electric Co. which he now holds.

Mr. E. A. **Barnes**, chief inspector of the works, received his early training with Patterson & Cooper in London. After arriving in the United States at the age of 21, in May, 1886, he secured a position with Bergmann & Co. in their 17th street factory, New York, where he was engaged in calibrating instruments of all kinds, and the testing of all apparatus, etc., manufactured by the company. Finding such work did not agree with his health, and having friends identified with a construction company engaged in installing Westinghouse plants, he went into partnership with them, and after working on several large contracts such as the Baldwin Locomotive Works and the Bergner Engel Brewing Co., business called him to Staten Island, where his firm were contractors for the wiring work on a large plant. Subsequently Mr. Barnes engaged with this local company as superintendent and electrician, and held that position until the plant was completed, when, having an offer from the Fort Wayne Electric Company in the construction department, he accepted it, and has served that department for the last five years.

During the World's Fair at Chicago Mr. Barnes had charge of the planning, etc., of the Fort Wayne Exhibit, and represented the company throughout the duration of the Fair; at its termination he was placed in the factory as Chief Inspector of the works.

ELECTRIC TRANSMISSION OF POWER IN BELGIUM.

The success of the installation at the Herstal Arms Factory at Liége, where the whole of the machinery is driven by electric motors, has given an impetus in Belgium to the industrial application of electric transmission. The Société de la Vieille Montagne, which at present have several steam power installations at different parts of their works, are going to abolish them, substituting one large central station, from which power will be transmitted electrically to where it is required. It is expected that this arrangement will result in economy being effected. M. Pieper, of Liége, is at present arranging a railway carriage for the Belgium State Railways in order to make experiments in connection with electric traction on railway lines of the standard gauge.

INDIA-RUBBER CABLES.

The Hooper's Telegraph and India-Rubber Works, Limited, will lay about 170 knots of cable for the Cuba Submarine Telegraph Company, Limited, between Cienfuegos and Batabano. It is interesting to record that this cable is to take the place of a guttapercha one, which, owing to its exhibiting further indications of depreciation, has now been abandoned entirely. Mr. Jno. P. Hooper, in 1891, made and laid a cable similar to the new one, the manufacture and laying being completed without a hitch.

Trade Notes and Novelties

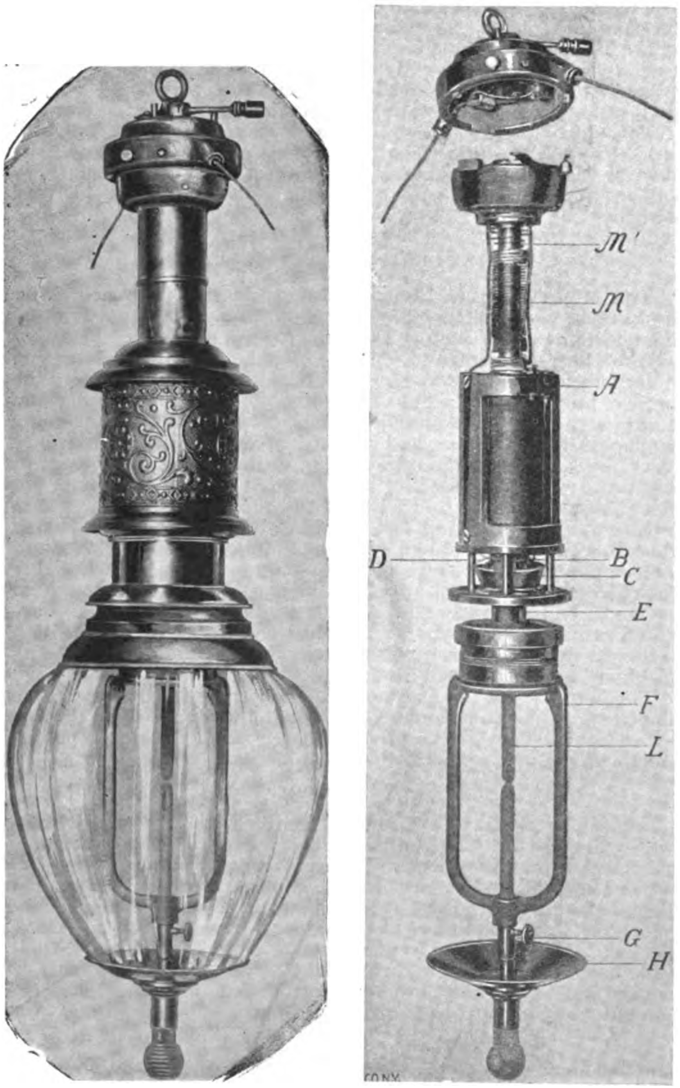
AND MECHANICAL DEPARTMENT.

THE MANHATTAN ARC LAMP.

We illustrate in the accompanying engravings the new "Manhattan" arc lamp which possesses features of novelty and utility that will without doubt attract the attention of central station managers.

In order to provide for simplicity of parts, economy in life of carbon, regularity of feed, etc., the entire mechanism has been designed so as to be concentric to the stem.

In the accompanying engravings, Fig. 1 shows the lamp complete, while Fig. 2 shows the skeleton of the lamp, the air tight shell at the centre being removed to show the feed mechanism. Here A is the magnet, B the armature carrying the clutch pan C, and engaging through suitable slots in the armature the clutch rings D, which have radial play within a slotted tube. In the upward travel of the armature B, the flaring pan C engages the clutch rings against the inserted upper carbon, raising it to form the arc. E is the negative terminal casting having an embossed cut-out seat. A cut-out ring held out of contact with the seat by an insulated spring is secured in the negative terminal casting E. The negative carbon frame F threads into the lower part of casting E and the slotted tube passes through the opening in casting E, the brush-box being screw-threaded to the end of the slotted tube and insulated from casting E.



FIGS. 1 AND 2.—THE MANHATTAN ARC LAMP.

In Fig. 2 the brush-box is concealed from view by the carbon frame F. The negative carbon clamp G is insulated from a dust-pan H, which has yielding contact against the lower opening in the air-tight globe; the upper carbon holder or sheath L is removable with the carbon. M is a resistance path to cut-out ring N, and M^1 (part of same resistance coil) is a shunt on the main coil of the magnet to regulate the length of the arc.

The circuit through the lamp is as follows: The current passes from the positive terminal through the main coil of magnet into the magnet A and slotted tube K to the brushes J and clutch rings D to the upper carbon, to the lower carbon and out through the negative terminal. It is provided with two paths; one through the main coil and carbons, and the other through the resistance M to the spring O and cut-out ring N, to the seat P of the casting E and out through the negative terminal. An insulating washer separates the armature B from the cut-out ring, the contact between the ring and seat being effected by the weight of armature B.

This arrangement makes a very perfect cut-out. It is only called into service, however, in cases of obstruction to the prompt descent of the upper carbon, which is a rare occurrence. In all other cases the cutting out is effected through the carbons themselves after being consumed to the predetermined point.

To shorten the lamp, the customary carbon rod has been dispensed with and a carbon sheath or holder feeding through the clutch rings with the bare carbon is substituted; and though the diameter of the sheath is appreciably larger than the carbon carried, they both feed through the clutch rings without any variation in voltage. This is due to a cushioned clutch feed without the usual "jump." The long standing objection to differential coil lamps, that of varying their voltage according to the temperature of the shunt coil, has been entirely avoided in this lamp, the voltage remaining the same, cold or hot.

If preferred, the carbon holder or sheath may be dispensed with and the carbon fed direct. It may be thought desirable to use an 18" carbon, which will cut out when burned down to the proper point, say, within five inches of the end; this stub may then be used as a lower carbon for another run.

A very important feature of the lamp covered by patent is the enclosed globe. The globe is air tight at all other points except at the bottom which is closed by the yielding pan H. This is claimed to be the only practicable method of preventing oxidation of carbons by closure that has yet been devised, as it makes practical the trimming and cleaning of globes without disturbing any air tight bearings. The globe is cushioned in its upper portion on soft asbestos gaskets and there made air tight. The lower part of the globe has a hand hole large enough to conveniently permit of cleaning and trimming. This hand hole is yieldingly closed by a detachable dust pan.

On the formation of an arc the enclosed air is heated and rarefied, the surplus air escaping through the lower vent. The contained oxygen is soon reduced by combustion with the carbon points to carbon monoxide and this with the remaining nitrogen surrounds the arc and protects the points from further combustion. These highly rarefied gases being much lighter than the surrounding comparatively cold air, have a tendency to rise, and finding no outlet at the top, remain in the globe to the exclusion of the surrounding air which is much colder and heavier and which can enter only by slow diffusion.

The lower carbon is secured in a socket fixed to the yielding pan. To trim the lamp the latter pan is unscrewed, when the upper carbon follows down after the lower and is removed; to place new carbons in the lamp the upper carbon is simply shoved up into place on the point of the lower carbon through the brush rings into the slotted tube, when the pan is screwed on and the lamp is ready to burn. The clutch rings grasp the carbon radially at the upper part and the brush rings centre it at the lower, thus insuring a perfectly vertical feed and preventing wedging of carbons.

The distance between the brush rings conveying current to the top carbon and the socket holding the lower is only about 8 inches. This distance usually varies from 18 inches to within the limits of their consumption, thus introducing a variation in the resistance and thereby variations of voltage and loss of power; to overcome this objection, it became necessary to use copper covered carbons. In the Manhattan lamp the small distance between the two carbons being constant and the resistance remaining constant, there is introduced no variation of voltage in the arc, and copper covered carbons are unnecessary. It will be noted also that the space between the top of the globe and the mechanism has been done away with, which not only greatly reduce the length of the lamp, but makes it particularly susceptible to decoration.

The lamp does not require a special grade of carbon and it is found that ordinary carbons burned in this enclosed chamber will last about five times as long, and a better quality of cored carbons about six times as long, as the same carbons burning in the open air.

The lamp illustrated in Fig. 1 is designed to burn one week on half night service without re-trimming. A similar lamp is made to burn about four nights on all night service or will require trimming but twice a week.

In central station service and particularly where lamps are distributed over considerable territory, the item of saving of labor in trimming will make the lamp particularly attractive commercially. The saving in cost of carbon and trimming with such a lamp, will amount to about $10 to $12 a lamp a year, or in most cases a good return on the entire cost of an arc light plant. In a municipal plant this would represent the saving of the interest charges on the entire issue of bonds necessary to construct the plant.

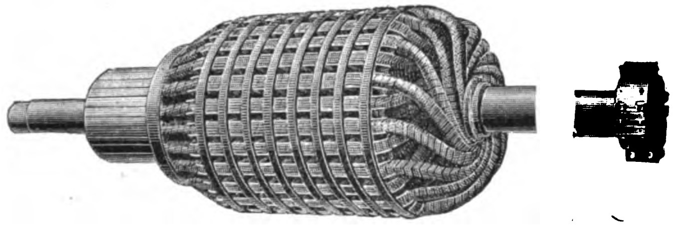
It has been found that in this enclosed chamber, it is possible to successfully burn a longer arc than in the open air and where desirable in series arc work a 2,000 candle power lamp can be run at about 75 volts and six amperes.

As the ½" carbons are only consumed at about the rate of one inch in four hours, it will be seen that the lamp seldom feeds, so that aside from the feature of the "sneak" feed provided in this lamp, the carbons are required to feed about one-fifth as often as an arc lamp burning in the open air and are consequently that much more regular and steady in burning. This will be appreciated in an outside lamp and particularly in a lamp on incandescent circuits.

The main features claimed for this lamp are, the great saving in trimming and the fact that ordinary carbons may be used, but above all, the simplicity of the mechanism. It will be seen that there have been eliminated all magnets with levers to multiply power, dash pots, racks, set screws and carbon rods, so that the cost of repairs should be reduced to a minimum. The lamp is manufactured by the Manhattan General Construction Company, No. 50 Broadway, New York City, and No. 753 Monadnock Building, Chicago, Ill.

THE RUSHMORE DRUM ARMATURE WINDING.

It was to produce a drum armature that should be a perfect mechanical balance with the coils all exactly alike and exposed to the air at all points, that Mr. S. W. Rushmore of 126 Liberty St., N. Y., designed the system of drum winding shown in the accompanying cut. In this winding the coils are first all cut to any required length and are all placed upon the armature in equal positions, while standing vertically, and are shaped upon each other in such a manner that they all cross the heads spirally, so that every coil is of exactly the same shape and none of the wires cross, but gradually lap past each other.



THE RUSHMORE ARMATURE WINDING.

It will be seen that the coils are practically independent on the heads and that they lie in such a manner that should the insulation become charred, there is no mechanical strain to produce a short circuit. With the coils exposed to the air at nearly all points, an armature wound on this system will carry a much larger current with safety, and having the coils exactly alike in shape and position on the core cannot but be an advantage, mechanically as well as electrically.

Mr. Rushmore is now winding this system for a number of the largest Edison and other stations all over the country and has rewound the standard types of armatures to this system as large as 250 h. p. In addition to this special drum armature winding, he is making a specialty of every class of heavy central station repairs and his factory at the foot of Morris St., Jersey City, is fully equipped with the heaviest class of machine tools required for this class of work and for the building of large low tension dynamos for copper refining and depositing.

The heavy machine floor is on the ground level, and over this is a complete factory equipped with the best class of machinery for the manufacture of arc lamps of every description, including a full line of search lamps for all classes of service, Mangin mirror lights, etc., and also of every kind of dynamo supplies; and a specialty is the building of large commutators.

Mr. Rushmore is making a specialty of completely rebuilding the largest station dynamos and now has orders on hand for overhauling and rebuilding the dynamos of two stations that were partly destroyed by fire, comprising fifteen large machines. The factory is supplied with every appliance for heavy work and is supplied with power for testing by a 250 h. p. Corliss engine in the basement.

Mr. Rushmore is about to place upon the market a new series arc lamp for street lighting that is designed to meet the requirements of rough service.

The Miller Mfg. Co. of Philadelphia, who are handling the "Shapleigh Wire Gauge," are so far behind with orders, they will be unable to deliver any gauges before July 1st.

THE COILED FILAMENT PACKARD LAMP.

The latest departure in the Packard lamp is the coiled filament Packard lamp, answering in appearance to the familiar straight filament lamp of the same make. Even an inexperienced eye cannot fail to be impressed with the graceful outline and general symmetry of this lamp, and to the person familiar with the lamp business it will be evident that the Packard coiled filament is a beautiful production. The New York & Ohio Co., the manufacturers of the coiled filament lamp, have moved slowly in bringing out a lamp of this kind, preferring to wait until they had fully satisfied themselves that it was the more desirable lamp under certain conditions. When they had convinced themselves of this fact, they proceeded to make a coiled filament lamp that would be in every way as nearly perfect as possible.

The coiled filament lamp is particularly adapted to high voltages and at present the New York & Ohio Co. are furnishing them only in lamps of from 100 to 110 volts. The coil in the long filaments, in addition to concentrating the light, also prevent the filament from falling against the bulb and shortening the life of the lamp. Further than this it renders the filament more rigid and less likely to be affected by the jarring of the building or its support and gives a longer life in buildings which are subject to vibration from the operation of machinery or other causes.

The above merits taken in connection with the graceful appearance of the lamp lead the New York & Ohio Co. and the Electric Appliance Company, their Western selling agents, to believe that the Packard coiled filament lamp will be very popular.

MIAMISBURG ELECTRIC CO.

The Miamisburg, O., Electric Co. report that they are doing remarkably well. They have been very busy of late getting the new addition to their factory in shape for the purposes, chiefly, of their battery department. Their Imperial dry battery has been undergoing some pretty severe tests since it was put on the market, but it has come out of the ordeal most successfully and is now in most active demand. It has had a special trial at many telephonic headquarters, and is being given the preference in a great many places as the result. The dealers are also finding out that this dry battery is not of a kind to go back upon them, but that thousands can be sold without the return of a single cell as defective or dead. Being free from local action when not in use, the cell does not run down while standing on the shelves, and there is none of the disagreeable creeping of salts. The Burnley Cartridge battery is also already recognized as a staple article of the trade, being greatly admired for its small paper porous cup, which cannot be broken, and its light weight. It thus ranks high in the sal ammoniac group of batteries, and is much called for by telephone companies, bell hangers etc.

The Miamisburg Co. also report a good trade in their tempered copper segments, the demand for which has doubled in the last few months. They claim to furnish segments free from porous and shrunken places and of the finest temper.

The Mica Insulator Co., 218 Water street, N.Y., have just issued a new catalogue of "Micanite," of which admirable specialty they are the sole manufacturers. The catalogue includes very full information as to Micanite plates, commutator segments, taper rings, band rings, troughs, field magnet and transformer spools, cylinders, washers, tubes, cloth, paper, insulator for rheostats, etc., etc. The company report that in spite of dull times, their trade has increased, the month of May record being the largest up to date. Micanite has now been introduced in Europe, and the demand is steadily growing from that quarter.

Ball & Wood Engines.—The beautiful new Bowery Bank building in New York is being equipped with the Ball & Wood engine for driving its electric lighting plant, and among other New York buildings which are using these engines are the Bonfils building to be occupied by Davis Collamore & Co., corner of Fifth Avenue and 22nd St., the Baer building occupied by Frank Leslie's Publishing Company, Bond Street, the Hotel Majestic, Lawyers' Title Insurance building and the Margaret apartment house, all of which have been installed within the last few weeks.

Northwestern Electrical Association.—The semi-annual meeting will take place at St. Paul, July 18th to 20th next, and all indications point to a liberal attendance. Arrangements are now being made to run a special convention train from Chicago via the Wisconsin Central Lines, and it is expected that a majority of the electrical fraternity will take advantage of the fact to spend a few days at the Minnesota capital.

☞ ***Departmental items of Electric Light, Electric Railways, Electric Power, Telegraph, Telephone, New Hotels, New Buildings, Apparatus Wanted, Financial, Miscellaneous, etc., will be found in the advertising pages.***

THE
Electrical Engineer.
A WEEKLY REVIEW OF THEORETICAL AND APPLIED ELECTRICITY.
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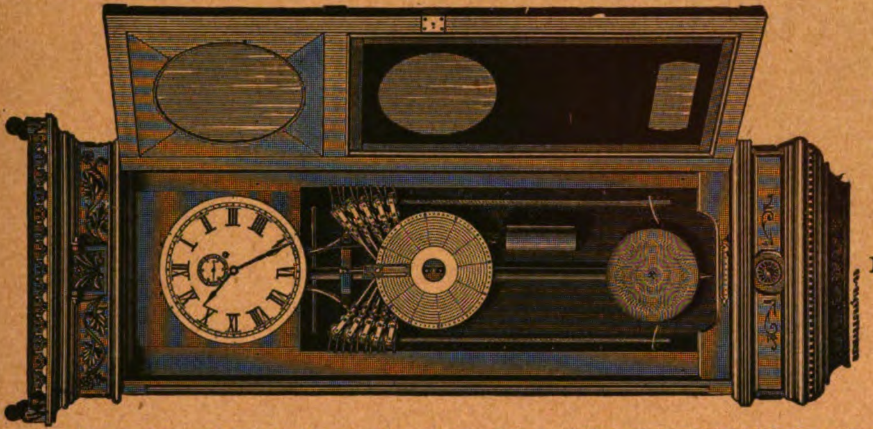

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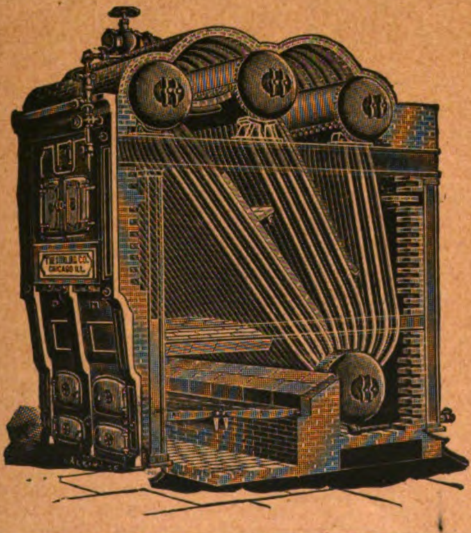

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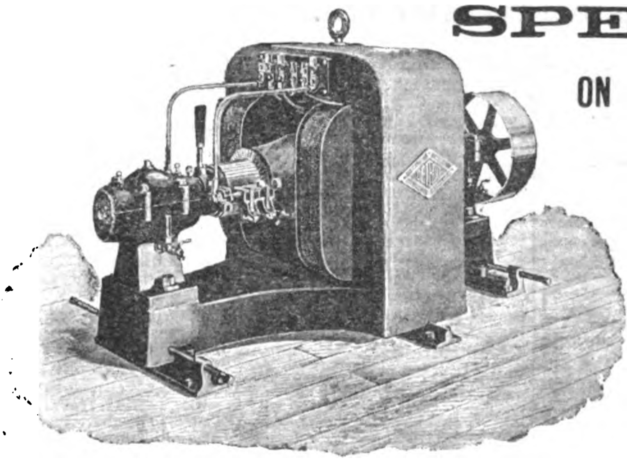

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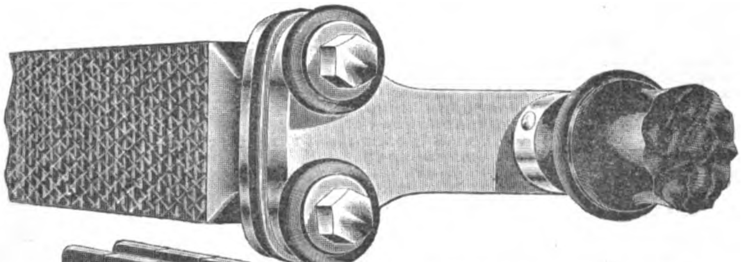

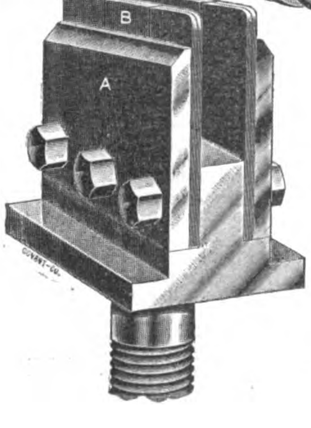

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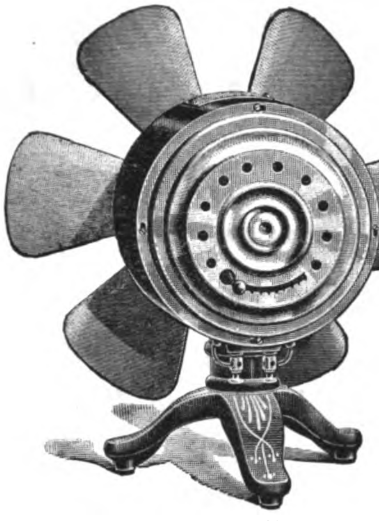

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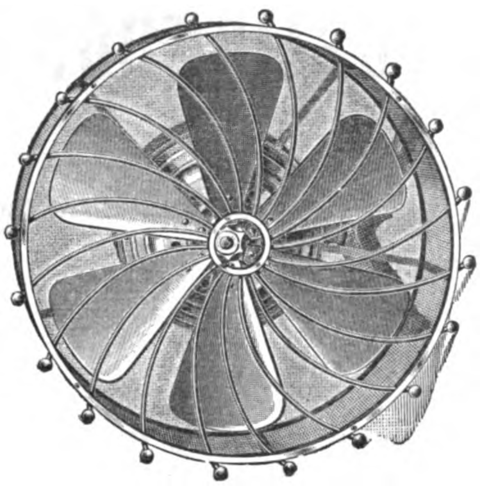

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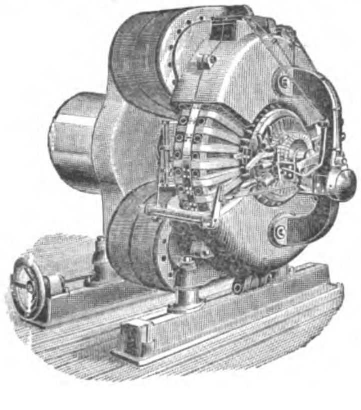

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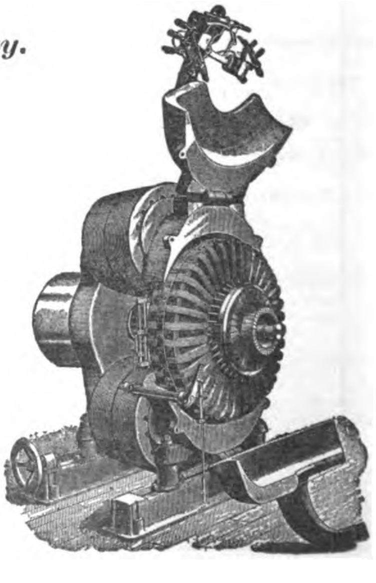

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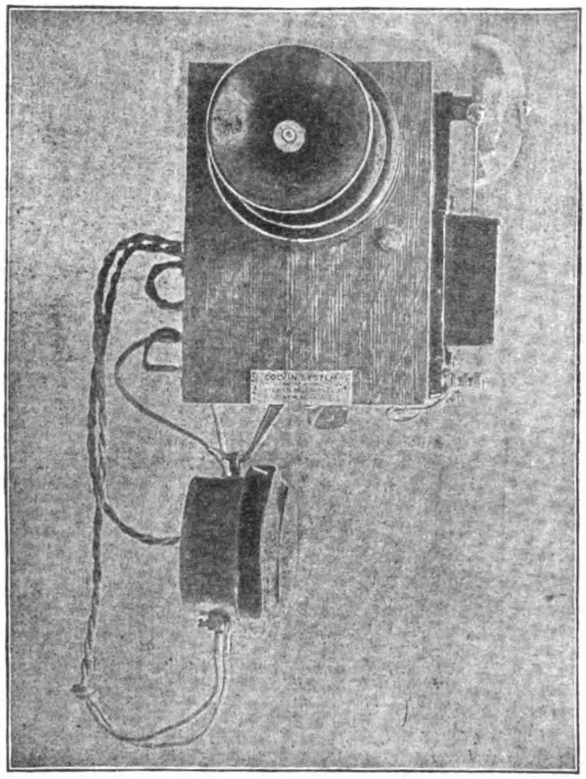

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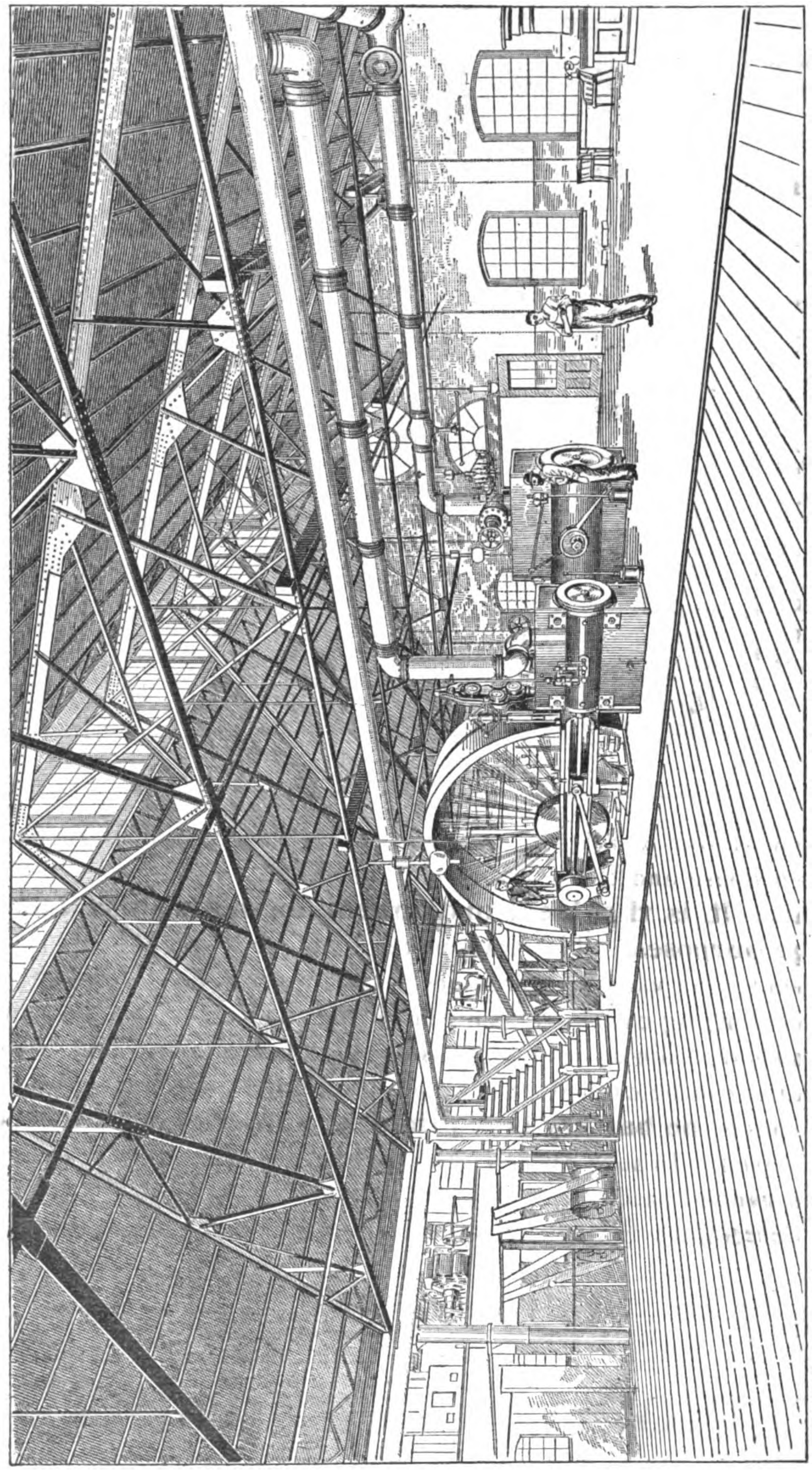

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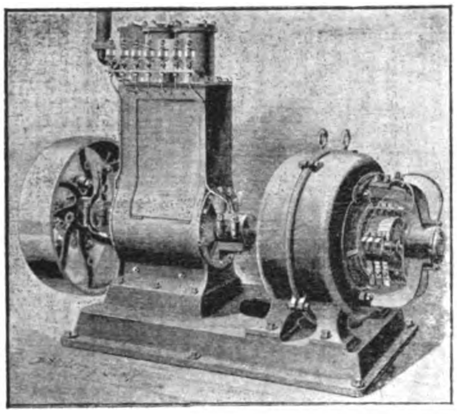

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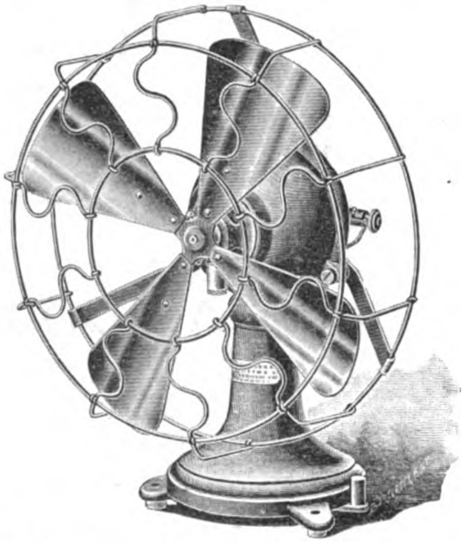

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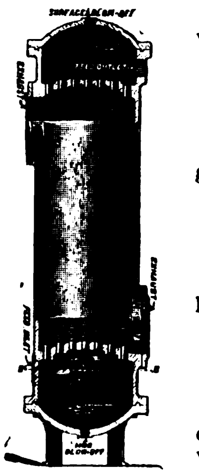

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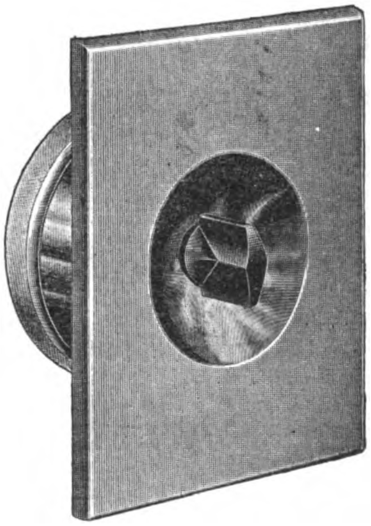

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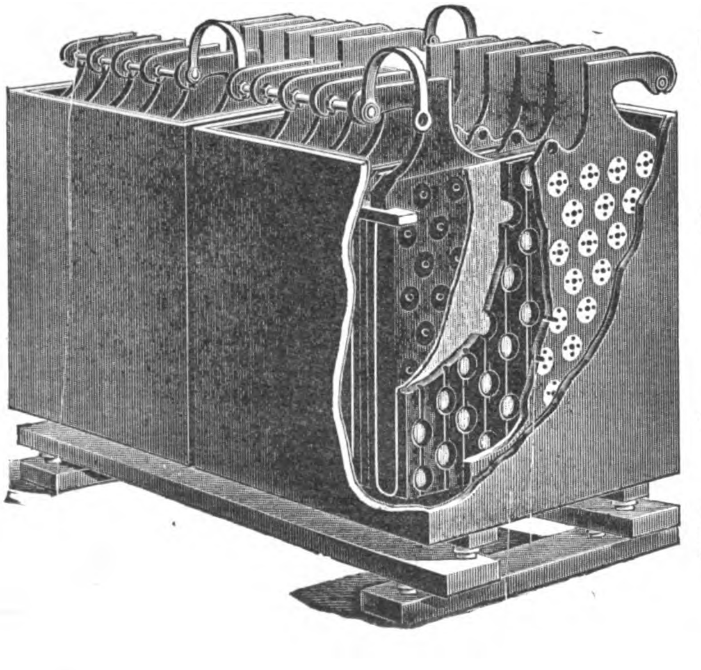

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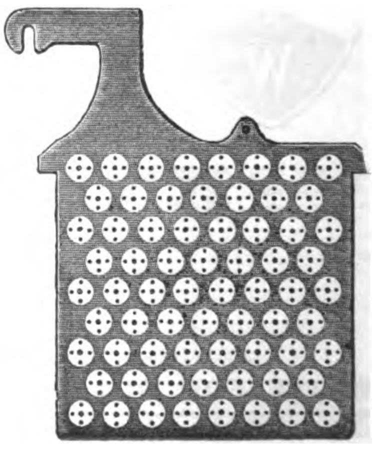

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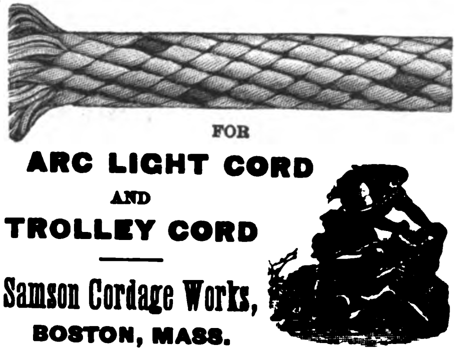

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GENERATORS, MOTORS, DYNAMOS, ARC LAMPS for arc and incandescent circuits, TRANSFORMERS and METERS. All of standard makes and sizes, and

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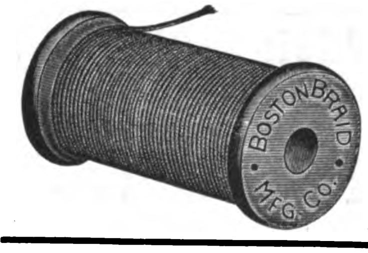
GENERAL AGENTS FOR
The L. P. & D. Transmitter Co. and The Belknap Motor Co.,
Manufacturers of DYNAMOS, MOTORS, ELECTRICAL SUPPLIES, and the COMPOSITE GRAPHITE and COPPER WOVEN WIRE BRUSHES.
Main Office, 620 Atlantic Avenue, Boston, Mass. Branch Office, 136 Liberty Street, New York.



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For Incandescent Lamp Filaments.

The greatest care taken in producing a uniform article. Used by the largest lamp manufacturers in the country.

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BOSTON'S ELECTRIC CENTRE.

Small, sunny rooms from $20.00 to $25.00 per month.

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Westinghouse Elec. and Mfg. Co.
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ADJUSTABLE HOLDERS FOR INCANDESCENT LAMPS.
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Octagonal Pine Poles,
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It will pay you to get our prices.
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Improved Automatic Cut-Off Engines,

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SIMPLE ENGINES, COMPOUND ENGINES, TRIPLE EXPANSION ENGINES, FOR **ELECTRIC LIGHTING PLANTS, ELECTRIC RAILWAY PLANTS, MANUFACTURING PLANTS,**

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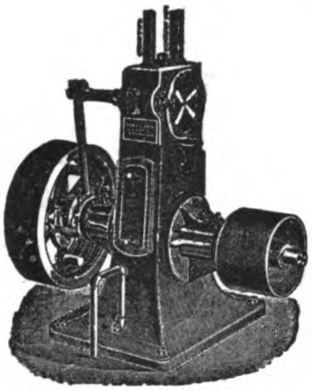

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ESPECIALLY ADAPTED FOR DIRECT CONNECTION.

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Buffalo, E. P. Little Elec. C. and S.
Albany, The Fairbanks Co. Co., 135 Seneca St.
Baltimore, D. E. Evans & Co., 7 Harrison St.
Providence, A. B. Pitkin Machinery Co.
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REWOUND AND REPAIRED. REFILLED.

Supplies for "American Arc Light System."

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QUICK BREAK KNIFE SWITCHES

Auto-Time Switches for Window Lights; Pendant Lamp Adjusters; Auto-Electric Ventilators; Auto-Electric Door Openers; 10 and 20 Ampere Flush Switches; Half Reflectors; Wireman's Mechanical Figuring Wire Gauge; Miller's Tempered Copper Segment.

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Cables and Insulated Wire Tested and Plants Installed.

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THE C. & C. ELECTRIC COMPANY,

Manufacturers of

Bipolar Dynamos up to 100 H. P.
Electric Motors, Automatic or Hand Controlled.
Complete Plants for Power Transmission.
Isolated Lighting Plants, Central Station Apparatus.

Multipolar Dynamos,

Direct Driven or Belted.

IN SIZES UP TO 250 H. P.

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Works: Garwood, N. J.
On Central R. R. of N. J.

BRANCH OFFICES:
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FOR SALE.

17 Excelsior 1,200 candle-power lamps as good as new. Will be sold cheap.

Also, one 115 horse-power Phœnix Automatic Engine—practically new.

Address,
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FOR SALE.

The entire stock of Brush Copper of the late Ansonia Electric Co.—5,000 pounds—all sizes, at 15 cents per pound. Porcelain Cut-outs (Edison makes), all sizes, at 75 per cent. off Edison List. Bryant 15 ampere Double Pole Switches at 60 cents. Sawyer-Mann 10 ampere Main Line Cut-outs at 15 cents. Write us for ANYTHING you may want. We may have it.

Chas. E. Gregory Co.,
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FOR SALE.

Thomson-Houston arc dynamo, 25 light, 2,000 c. p.

One new armature for above.

A lot of K2 and D lamps.

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To trade new Transformers for small 1000-volt Alternator. Address,

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A 100-light, 80-volt "Consolidated" Dynamo, belt and adjustable frame, in good order. Price low.

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Address, **EAMES,**
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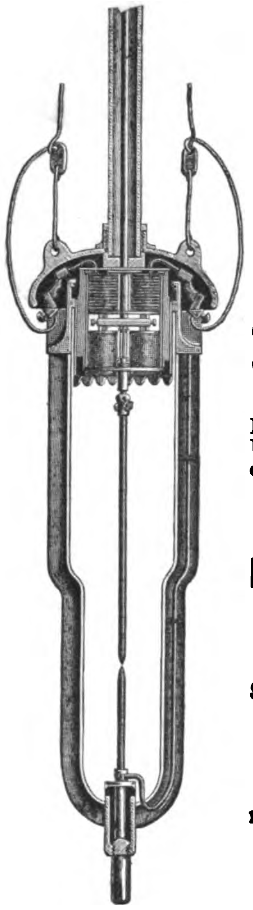
See further, page xiv.



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Will stand the
WATERHOUSE, GAMBLE & CO.
ARC LAMP
FOR
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A slight examination will prove it to be a
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It has recently been adopted by the Boston & Maine R. R. Co. for their new UNION STATION after a test of seven other well known lamps.

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THE PERKINS
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If you are in need of
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Write to us NOW. Send for Catalogue.

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ARC LAMP
FOR ALL CIRCUITS.

Constant Current
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LONG DISTANCE TRANSMISSION

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Two-Phase Generator

which possesses many novel features which will at once commend it to any practical man.

We now offer the most complete multiphase system ever produced, combining a line of

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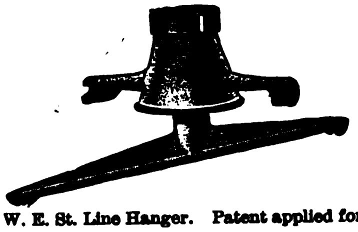
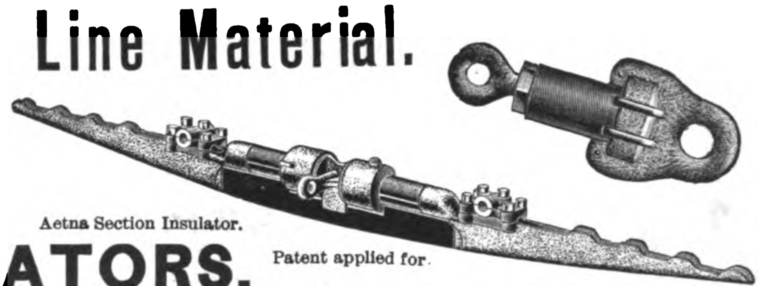


W. E. St. Line Hanger. Patent applied for.

Anderson Line Material.

AETNA



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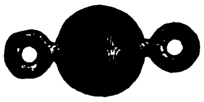

THE AMERICAN BELL TELEPHONE COMPANY,

125 MILK STREET, BOSTON, MASS.

THIS Company owns Letters-Patent No. 463,569, granted to Emile Berliner November 17, 1891, for a combined telegraph and telephone, and controls Letters-Patent No. 474,231, granted to Thomas A. Edison May 8, 1892, for a speaking telegraph, which Patents cover fundamental inventions and embrace all forms of microphone transmitters and of carbon telephones.

STEPHEN B. ELKINS, Pres. PATRICK EGAN, Sec. H. J. HANFORD, Gen'l Mgr.

THE HARRISON

INTERNATIONAL TELEPHONE CO.

What Money can Earn and the PEOPLE SAVE

BY MEANS OF THE

HARRISON INTERNATIONAL TELEPHONE.

This Company owns Letters Patent No. 476,200, granted to E. M. Harrison, May 30, 1892, and Letters Patent No. 499,108 granted to E. M. Harrison, June 6, 1890, for a complete electric speaking telephone operated by battery. And owns Letters Patent No. 435,295 granted to William Hutson Ford, August 26, 1890, for an automatic switchboard. Our patents embrace every device necessary in the construction of a telephone plant with either manual or automatic switchboard.

We either lease our telephones for a term of years or sell them outright.

Prospectuses furnished by addressing the Company at their offices,

AGENTS TERRITORIES NOW BEING ALLOTTED. WRITE AT ONCE.

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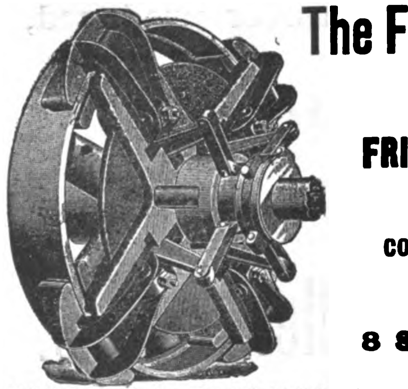

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The Falls Rivet and Machine Co.,

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MANUFACTURERS OF

FRICTION CLUTCHES, SHAFTING, etc.

SPECIAL ATTENTION GIVEN TO THE COMPLETE EQUIPMENT OF ELECTRIC PLANTS.

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Energetic Engineer (Scientific and Practical), conversant with English, over five years in the largest European Accumulator Factory (System Tüdor), thoroughly familiar with the entire manufacture of Accumulators, is open to accept engagement to establish factory for manufacture of same upon the latest improved principles. Highest references. Address offers to,

O. H 65,570,
Care, Albert Frank & Co.,
159 Broadway, New York.

WANTED.

Position by young man, with electric light or power company. Has had three years' experience. Can furnish references,

Address, A. W.,
Care THE ELECTRICAL ENGINEER,
203 Broadway, New York.

ELECTRIC RAILWAYS.

Hartford, Conn.—The many Hartford people who visit Watch Hill in the summer will be interested to know that an electric trolley road is to be introduced into Westerly and a branch line extended to Watch Hill. The road will be in running order some time next month.

Carlisle, Pa.—The Carlisle Trolley Company have secured the right of way across the People's Bridge at Harrisburg and will soon commence work at that end of the line. They will build a line from Harrisburg across the bridge and up the valley. They expect to have the track laid as far to White Hill before winter sets in.

Sioux City, Ia.—A bill of sale has been filed for record by Receiver Moller, of the Sioux City Cable Railway Company, transferring to the Sioux City Electric Company all its electric machinery, poles, wires, electric light equipment, etc., for a consideration of $11,000. The electric company has for some time been furnishing the light circuit and the power for the road since it was changed.

White Plains, N. Y.—A company composed of local business men, will apply to the Board of Trustees in White Plains soon for a franchise for the building of an electric railroad through the village from Elmsford to Mamaroneck. Among the promoters of this new corporation are S. L. H. Ward, E. C. Sniffin, John Duffy, S. Gainsboro, Edward Phelps and others.

See further, page xvi.

Siemens & Halske Electric Company of America,

Siemens & Halske: Berlin, Charlottenburg, Vienna, St. Petersburg.

—— MANUFACTURERS OF ——

DIRECT CURRENT MULTIPOLAR DYNAMOS AND GENERATORS.

These machines are constructed with outside revolving armatures, without and with special commutator, as desired. They have proved remarkably efficient and economical. Used largely in European Central Stations. They are slow-speed machines, made for direct connection to engine without belting, and in sizes from 20 H. P. to 1,500 H. P.

HIGH-SPEED BELTED SIEMENS DYNAMOS

Are copied extensively in this country as "Drum Type." We are building these machines in sizes from 1 H. P. to 150 H. P.

ALTERNATING AND MULTIPHASE CURRENT DYNAMOS

With laminated field and armature, in sizes from 1 H. P. to 4,000 H. P., for belted or direct coupling.

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Of every speed for direct, alternating or multiphase current, in sizes from 1-10 H. P. up to 4,000 H. P. Durable and economical in operation.

SIEMENS BAND LAMPS

For direct and alternating current, for constant potential and series machines.

SIEMENS ARC LIGHT CARBONS

With either solid or soft cores, which are the most economical in the world and give a steady light.

ALL INSTRUMENTS

Requisite for the regulation of electric apparatus; also the Siemens Voltmeters and Ammeters and Automatic devices made in Berlin.

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San Francisco Office, 508 California Street.
Minneapolis Office, 939 Lumber Exchange.

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These goods are made of the **BEST CHARCOAL IRON**, carefully annealed; they are free from burrs and perfectly flat.

A uniformly high standard of magnetic permeability can be relied upon.

JOSEPH SANKEY & SONS,
Bilston, England.

Swedish Charcoal Iron Stampings, Armature Discs and Washers, Transformer, Field Magnet and other Stampings.

GEO. L. COLGATE, American Sales Agent, 136 Liberty St., New York.

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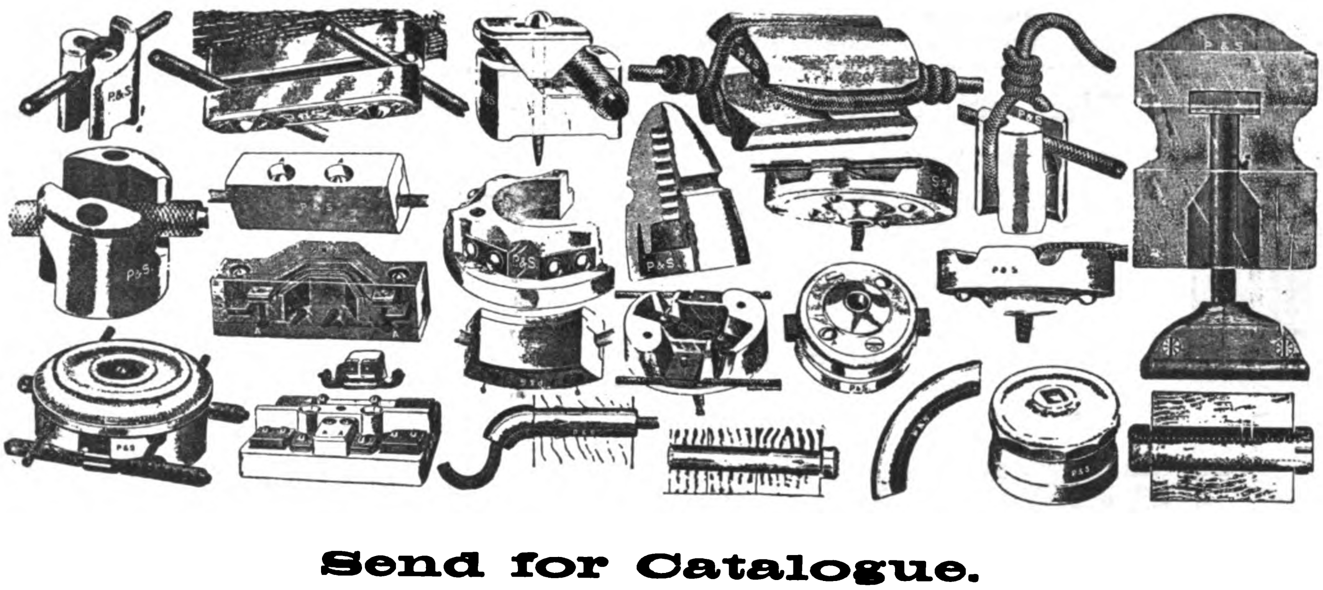

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NEW YORK INSULATED WIRE CO.

SOLE MANUFACTURERS

GRIMSHAW White Core Wires, Raven Core Wires, Competition Line Wires, GRIMSHAW Tapes, Competition Tapes, Splicing Compounds, Etc.

Vulca Electrical Wire Ducts for Interior Construction. A Complete Method for all Electrical Systems. Junction Boxes, Cut-Outs, Angle Boxes, Etc., Etc. Vulca Coupling Compound.

Nos. 13, 15 and 17 Cortlandt Street, New York.
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PHILADELPHIA CORLISS ENGINES.
AIR PUMPS AND CONDENSERS.
BAND AND FLY WHEELS. STEEL-PLATE CHIMNEYS.
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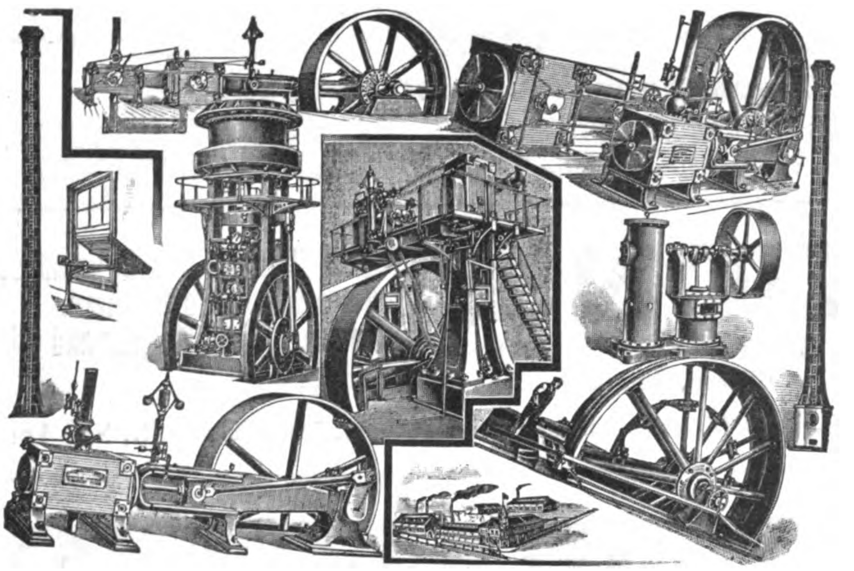

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MIFFLIN STREET, EAST OF FRONT,
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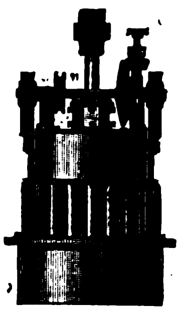
W. F. PARISH MACHINERY CO., Home Insurance Building, Chicago, Ill.



The McCormick Turbine,
On Vertical or Horizontal Shaft,

Gives more power as to diameter with a higher percentage of useful effect than any water wheel heretofore made. All sizes of these wheels, Right and Left hand, are built from patterns perfected under systematic tests in the Holyoke Testing Flume at an expenditure of over twenty thousand dollars. Parties having power plants which are unsatisfactory, and those contemplating the improvement of powers will find it to their interest to confer with me as I am willing to guarantee results where others have failed. State requirements and send for catalogue.

Estimates Furnished for Complete Power Plants and Results Guaranteed.

S. MORGAN SMITH,
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TELEPHONES!!

This Company is manufacturing A COMPOUND MAGNETO TELEPHONE, which it sells outright under a guarantee both as to EFFICIENCY and as against INFRINGEMENT OF PATENTS.

It talks as well over one hundred miles as any other Telephone talks over one mile.

This Company is also prepared to fully equip TELEPHONE EXCHANGES furnishing everything from the telephones to the wire and poles), PRIVATE LINES, FACTORY PLANTS, etc., and does all kinds of CONSTRUCTION WORK.

Send for Circulars and Price Lists.

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CATCH IT?
Well!
I Wonder if they Won't!!

THE GARTON LIGHTNING ARRESTER PAT'D SEPT. 30, 1892

You need never have your apparatus injured by lightning if you install the

Garton Arresters.

Made in all styles for use on either DIRECT or ALTERNATING current circuits.

Get our new Catalogue and Prices.

GARTON-DANIELS ELECTRIC CO.,
KEOKUK, IA., U. S. A.

ELECTRIC LIGHT.

Concord, N. H.—The Northern Electrical Supply company electrical contractors of this city have been awarded the contract to put in a 800-light electric plant at the Gilmanton mills at Belmont.

Scotland Neck, N. C.—Messrs. George W. Coughenour and S. F Dunn, who have leased the large mill property of W. H. Kitchin, say they expect to put in an electric plant and furnish the town with electric lights.

Rutland, Vt.—The property of the Marble City Electric company has been attached for the sum of $5,000 in a suit brought by the Rutland Electric Light company. The attachment includes the new building on Post street and all their poles, lamps, dynamos, etc.

Mamaroneck, N. Y.—The iron roofs are being put on the buildings of the Mamaroneck Electric Light company. The town board of Mamaroneck has extended the time by which the Larchmont Electric company must have its plant completed, poles set and wires strung, until Sept. 1st next.

Ottawa, Ill.—The Illinois Valley Electric Light and Power company has been forced to the wall by two judgments aggregating $11,000, one for $9,800 on six notes held by the National City Bank, and the other for $1,200, held by Col. Fullerton. The company has operated an extensive plant for Ottawa and Marseilles, and has been in business about five years.

Fitchburg, Mass.—The Kimball Electric company have been awarded the entire electrical contract for the new Y. M. C. A. building. This will include the wiring for the electric light and electric gas lighting, electric locks, bells and speaking tubes. They have also obtained the contract for the electrical equipment of the town hall now being built in Leominster.

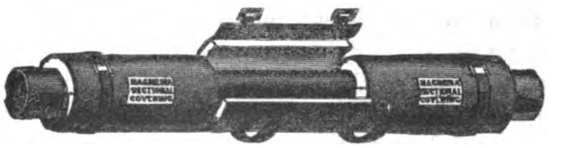
Monterey, Mex.—The electric light plant under construction at the Monterey and Mexican Gulf Railway station in this city is said to be nearly ready to put in operation. It will be used in lighting up the central offices of the company, which are located in their handsome depot building. The shops, round house, freight building and other buildings of the company will also be lighted by their electric plant, as well as the station grounds.

See further, page xvii.

J. G. Brill Company,
PHILADELPHIA.
Western Office: PHENIX BUILDING, CHICAGO.

BUILDERS of Tramway Cars of all kinds. Patented Trucks for Motor Cars, Electric Cables, etc. Inventors and Builders of the Patented Maximum Traction Pivotal Trucks. SPECIAL attention given to cars of new designs. Prices and information furnished promptly on application. Electric Snow Ploughs and Sweepers.

The **CLARK** ELECTRIC CO., 192 Broadway, New York.
Is the only concern in the world that make
ARC LIGHTING
Apparatus for every purpose, and for use on every current. Our Arc Lamps can be used on any current whatever.



You Insulate electrical conductors well; why not insulate steam "conductors" well? Why not use

MAGNESIA SECTIONAL PIPE COVERING?

THE KEASBEY & MATTISON CO.

Agents: NEW YORK: Robt. A. Keasbey, 54 Warren Street.
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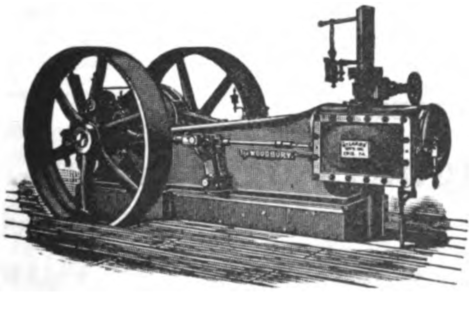
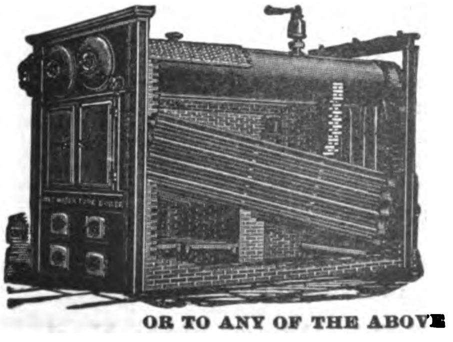
STEARNS MANUFACTURING CO.

WOODBURY AUTOMATIC ENGINES.

POINTS OF MERIT:
Balanced Slide Valve which will stay tight.
Governor with only one spring and few parts.
Extra large wearing surfaces, pins and journals.
Great weight, suited for continuous heavy duty.
Convenient for examinations and adjustments.

Catalogues and prices sent on application to
MAIN OFFICE AND WORKS AT ERIE, PA.
BRANCH OFFICES:
New York, 136 Liberty Street.
Philadelphia, 944 Drexel Building.
Chicago, 1120 The Rookery.
San Francisco, 29 and 31 Spear Street.
AGENCIES:
St. Louis—M. P. Johnston Machinery Co., 715 and 717 North Second Street.
Minneapolis—T. M. Maguire, 23 Syndicate Block.





Gill's Patent Water Tube Steam Boiler

Has all the properties required for the best steam generator that can be built, viz:
The Greatest Safety for fireman as well as owner.
The Greatest Economy in Fuel attainable.
Occupies the smallest amount of ground space.
All the parts are accessible for examination and cleaning.
The most thorough circulation of the water is insured. Catalogues and prices sent upon application to

John L. Gill, Jr., Drexel Bldg., Philadelphia, Pa.

OR TO ANY OF THE ABOVE OFFICES OF THE COMPANY.

INVESTIGATE.

The Leonard Method of Control for Electric Motors.

Especially adapted to Pumps, Hoists, Elevators, Locomotives, Cranes, Ventilating Fans, etc.

Perfect efficiency at any speed and torque and in either direction.

Will hold any speed desired automatically constant under varying load.

No rheostats, mechanical brakes, dash-pots, automatic switches, and no sparking anywhere under any conditions.

Power required to start full load from dead rest not more than 10 per cent. of any other method.

Reversible under full load at full speed with perfect results.

The only practicable system for operating large motors for pumps, hoists, locomotives, etc.

Thoroughly protected by patents and free from any infringement.

Applicable to any standard motor without any alteration.

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FINANCIAL.

Chicago, Ill.—The Sperry Electric Company, Chicago, certified to a decrease in capital stock from $100,000 to $10,000.

New York, N. Y.—The United Electric Light and Power Company of New York certifies that it has increased its capital stock from $5,500,000 to $6,000,000. The amount of capital actually paid in is $2,049 600, and the amount of the company's debts and liabilities is $2,946,570.

Battle Creek, Mich.—The Citizens' Electric Light company has increased its capital stock from $50,000 to $150,000. Part of this will be given to the present stockholders, and the balance held in reserve to sell when they need more money to enlarge their business. The old officers were all re-elected for the coming year.

MISCELLANEOUS.

Hamilton, O.—The Ryan Dynamo Company has been formed; capital stock, $10,000.

Phoenix, N. Y.—The Syracuse Electric Storage Battery company have moved their manufactory to Phoenix.

Gloucester, Pa.—At the annual meeting of the Electric Storage Battery Company of Gloucester City the following officers were elected: President, W. W. Gibbs; Vice President, Randall Morgan; Secretary, B. W. Tingley; Treasurer, W. G. Warden, Jr.; Directors, Samuel F. Bodine, Isaac T. Rice, Randall Morgan, Waldron Shapleigh and W. W. Gibbs.

See further, page xxii.

PROSPECTUS.

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Recognizing the growing need for accurate elementary instruction in the principles of electricity and magnetism as applied to electrical engineering, the authors have endeavored to present, in a readily accessible form, an accurate delineation of these sciences in their latest development.

There is a growing desire on the part of students throughout the country to take up the study of electrical engineering, a subject of daily increasing practical importance and prominence. Facilities for its proper study are, however, noticeably limited even in the neighborhood of large cities, and but comparatively few students have enjoyed the requisite preparatory training for such study.

The authors believe that these obstacles to a more widespread study, will be in a large measure, removed by the publication of a series of inexpensive leaflets, in three grades, giving in a reliable and authoritative manner, the principles of electrical engineering.

Though the three grades of leaflets devoted to the same subject are in supplementary sequence as regards treatment and detail, each grade being a preliminary to the study of the next higher grade, yet to avoid the danger of confusing students with methods and demonstrations beyond their acquirements, each grade has been designed as a complete course in itself.

The Leaflets of each grade will be issued in thirty-five weekly parts, that is to say, there will be three Leaflets each week—**Elementary, Intermediate** and **Advanced**—for a period of thirty-five weeks. Each Leaflet will consist of 8 pages, of small octavo size, and the whole will be illustrated by diagrams and drawings, intended for elucidation of the text rather than for pictorial effect.

Publication will commence not later than June 16.

The price of the Leaflets will be 10 cents each.

The subscription price will be $3.00 for each series of 35 issues.

Below is a table of the topics, each of which is treated in the **THREE GRADES.**

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1. Electrical Effects.
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3. Electric Resistance.
4. Electric Resistance.
5. Electric Resistance.
6. Electric Current.
7. Ohm's Law.
8. Electric Circuits.
9. The Voltaic Cell.
10. The Voltaic Cell.
11. The Voltaic Cell.
12. Magnetic Flux.
13. Magnetomotive Force.
14. Magnetic Reluctance.
15. Electromagnets.
16. Induced Electromotive Force.
17. The Dynamo.
18. The Dynamo.
19. The Dynamo.
20. The Regulation of Dynamos.
21. Electro-dynamics.
22. Electric Motors. Continuous Current Type.
23. Electric Motors. Continuous Current Type.
24. Electric Motors. Continuous Current Type.
25. Electric Heating.
26. Incandescent Lighting.
27. Incandescent Lighting.
28. Arc Lighting.
29. Arc Lighting.
30. Alternating Currents.
31. Alternating Currents.
32. Alternating Currents.
33. Alternators.
34. Alternators.
35. Alternating Current Transformers.

Further details will be published in due course. Samples of the Leaflet will be furnished on application. For nature of contents, see Leaflet No. 1, **Elementary Grade**, printed in The Electrical Engineer of May 30, 1894.

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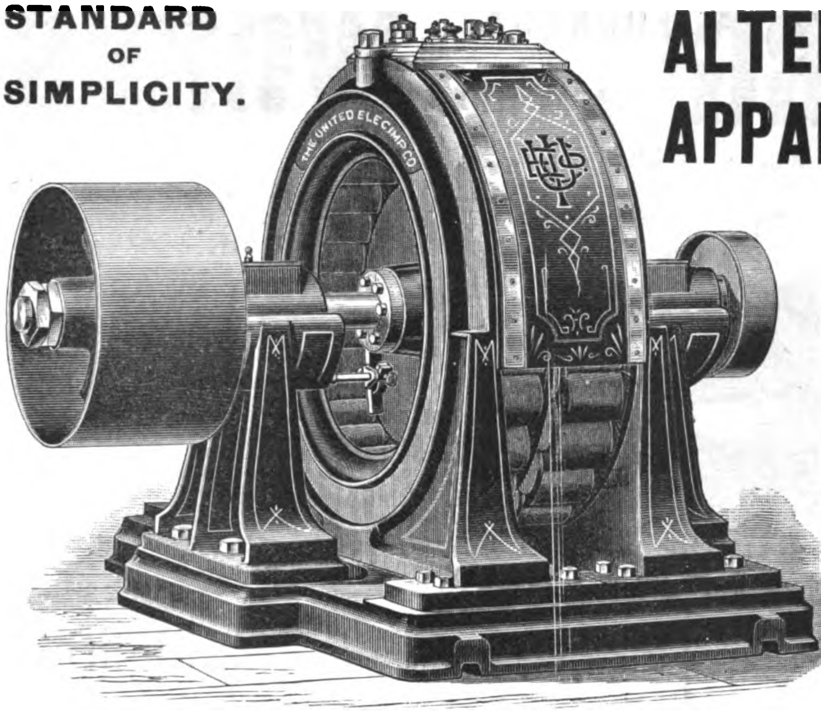
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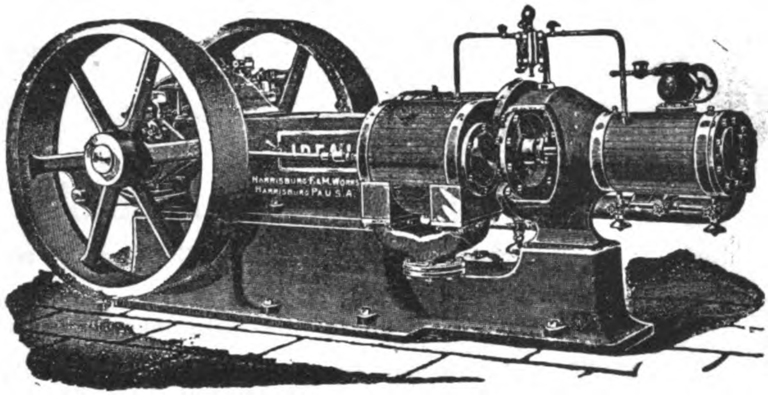

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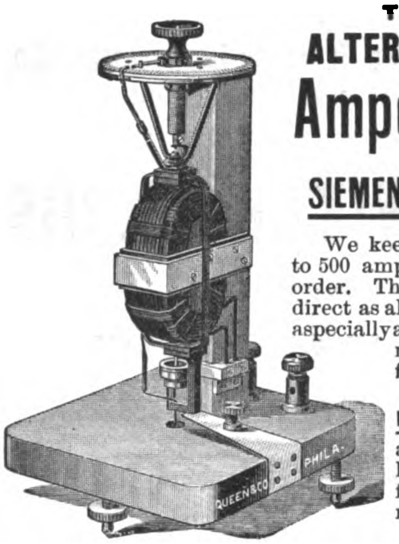

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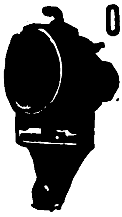

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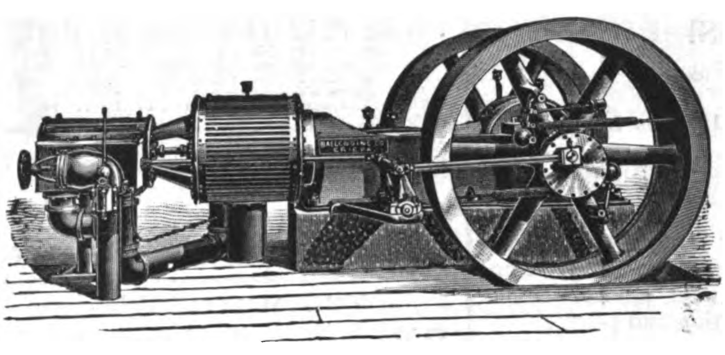

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The author discribes all the more general forms of dynamometers including friction brakes, absorption and transmission dynamometers, and devotes attention to the power required to drive lathes and other machinery. The chapter on the measurement of water power will also prove useful to many. The book is well illustrated throughout, and the subject treated from a thoroughly practical stand point.

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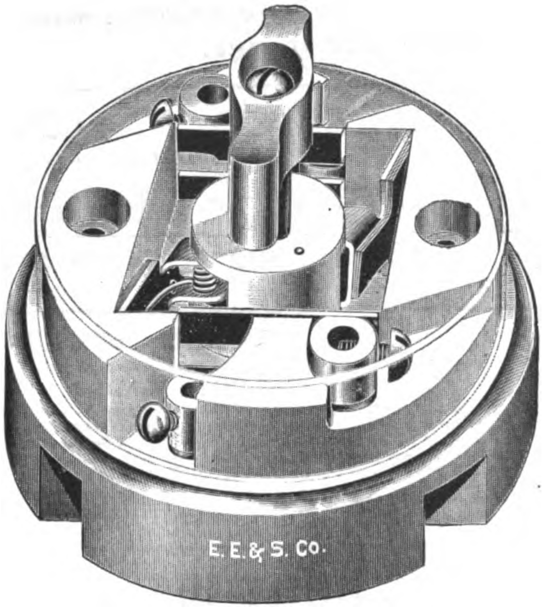

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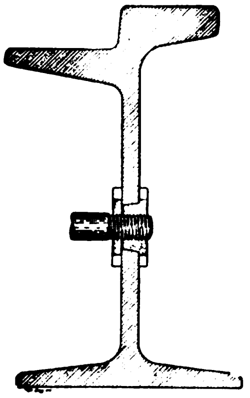

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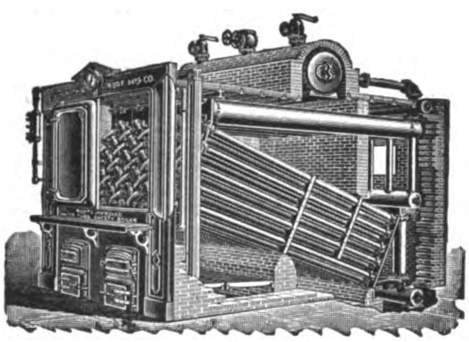

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ELECTRIC RAILWAYS.

Albany, Ore.—Surveys are being made for a motor line between Albany and Sodaville.

Radford, Va.—The new electric car line has been opened and is quite a success.

Holyoke, Mass.—The street railway company has petitioned for right to extend its tracks.

Baltimore, Md.—The electric line to Clifton will soon be begun, the City Passenger Railway having secured all necessary rights of way.

Brooklyn, N. Y.—The Coney Island, Fort Hamilton & Brooklyn R. R. is to be extended in Kings County from Fifth Ave. to New York Bay.

Niagara Falls, N. Y.—The Niagara Falls, Whirlpool & Northern Electric R. R. Co. has awarded a contract to J. W. Hoffman & Co. for the construction of a road to the Devil's Hole.

Denver, Col.—The Willow Creek R.R. Co. has been incorporated with a capital stock of $10,000 by S. S. Gill, W. J. Fine and John Latimer to build a road in Gunnison county.

Belle Vue, Neb.—A committee consisting of W. R. Patrick, William Martin, Dr. W. C. Buel and others, has been appointed to make arrangements for extending the electric railway from South Omaha to this place.

Reading, Mass.—Electric car communication between Reading, Wakefield and towns and cities intervening between here and Boston, to Lynn, Salem, Newburyport in the east, and Woburn, Stoneham, Winchester and other cities and towns in the west, is established.

Sing Sing, N. Y.—The Sing Sing Electric Railroad has been in operation a year now, and during that time, in a village of 10,000 inhabitants, has carried 401,144 paying passengers, or an average of 1,100 a day.

Philadelphia, Pa.—A charter has just been granted at Harrisburg to the Roxborough, Chestnut Hill and Norristown Traction Company, of Philadelphia, capital $5,000. The incorporators are William H. Heulings, Jr., John T. Dunlap, William J. Ferdinand, Henry C. Esling, of Philadelphia, and George W. Vanhorn, of Chester.

Atlantic City, N. J.—Mr. E. C. Woodward is interesting capitalists in an electric railway, direct from this city to New York. He thinks a two hours' line feasible and possible, one that would bring many New Yorkers here. This line will be built on the same plan as that now in progress between Chicago and St. Louis.

See further, page xxiii.

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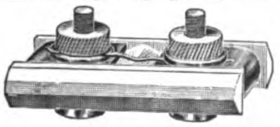

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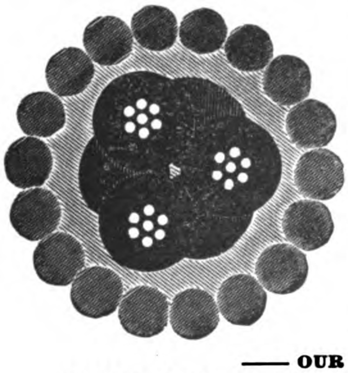

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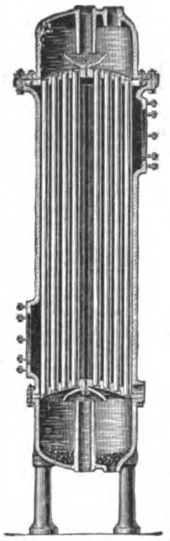

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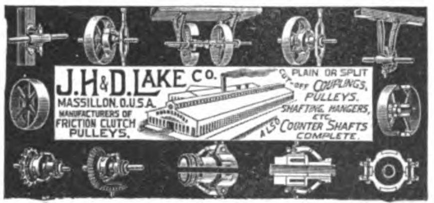

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ELECTRIC RAILWAYS.

Council Bluffs, Ia.—The Council Bluffs & Lake Manawa Electric Ry. Co. has been incorporated with a capital stock of $50,000. Directors, J. W. Bedford; L. H. Kent, J. P. Finley, H. B. Coryell.

Springfield, Mo.—The inter-urban electric railway, the controlling interest of which is owned by A. H. Rogers, of Springfield, is proving to be a paying enterprise. An extention of the line to Galena, Kan., is contemplated. When this is completed the electric railway will be thirty miles in length.

St. Louis, Mo.—The Southern Electric Railway Co. has petitioned for a franchise to extend its line.

Crisfield, Md.—A company has been formed to build an electric railway to connect with Mariners, Asbury and Apes Hole.

Portland, Ore.—The Portland Cable Ry. Co. is reported as having estimates made for changing the motive power to electricity.

Terre Haute, Ind.—The Terre Haute Electric Ry. Co. has been organized; capital stock, $500,000. Directors, P. P. Thomas, J. G. McNutt, M. F. Burke.

Rome, N. Y.—The Rome City Street Railway Co. is making arrangements to change the motive power of the road to electricity. W. P. Rayland, Secy. and Treas.

Hartford, Conn.—The people of this town and borough are looking to the board of warden and burgesses to give the Bristol and Plainville Tramway Company power to build their line under conditions that can be reasonably complied with.

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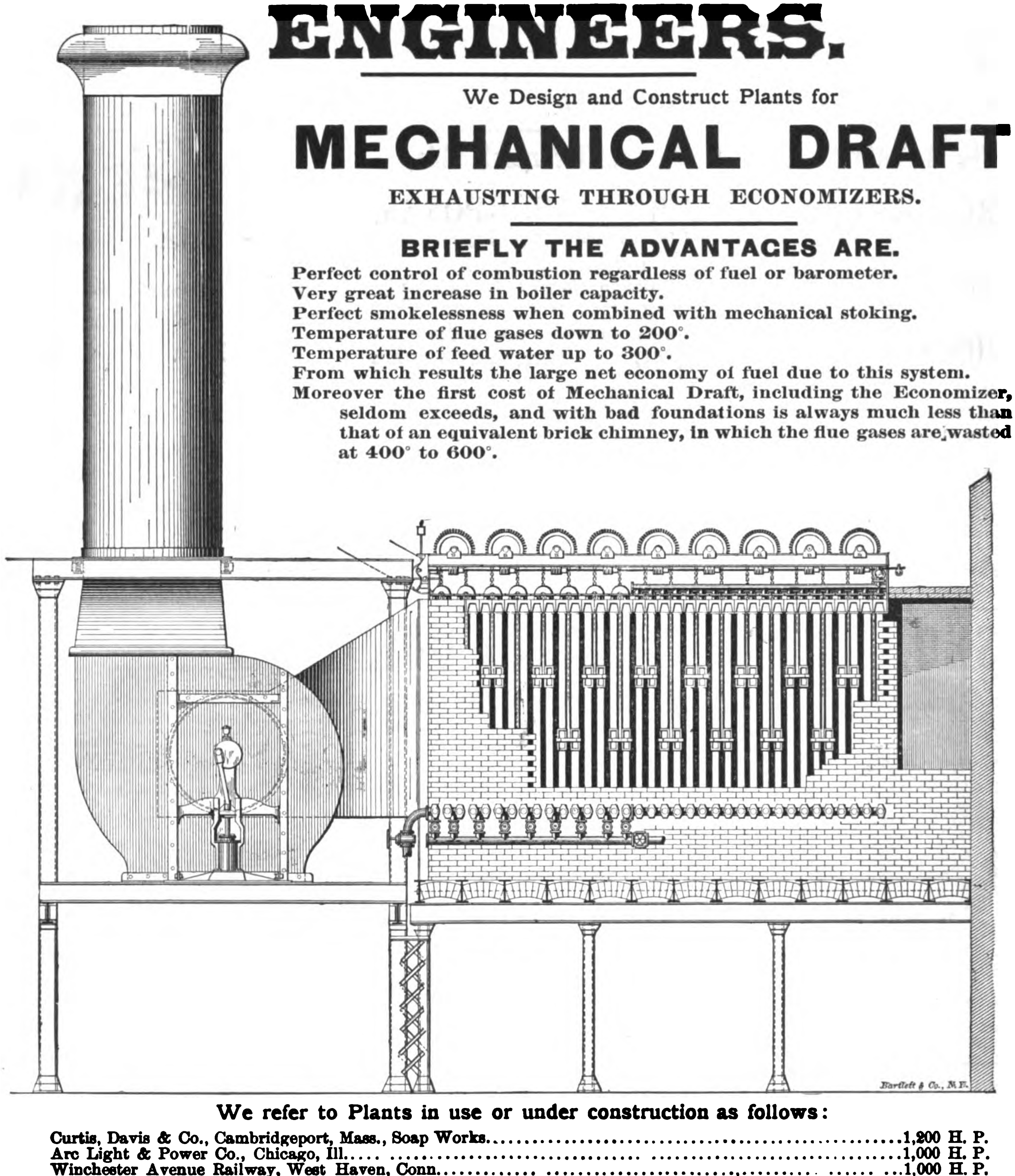

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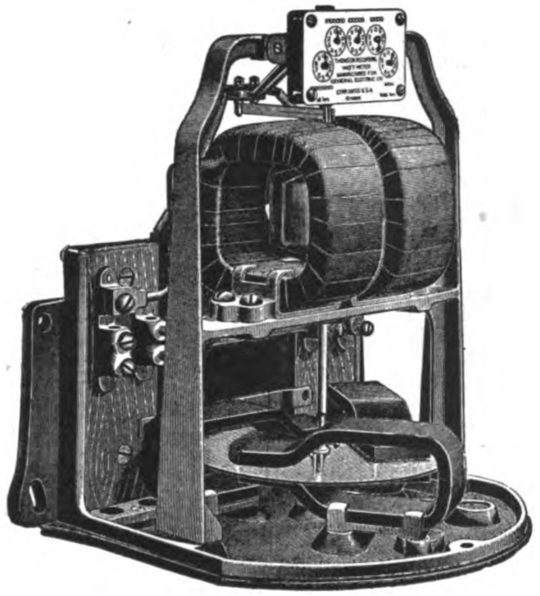

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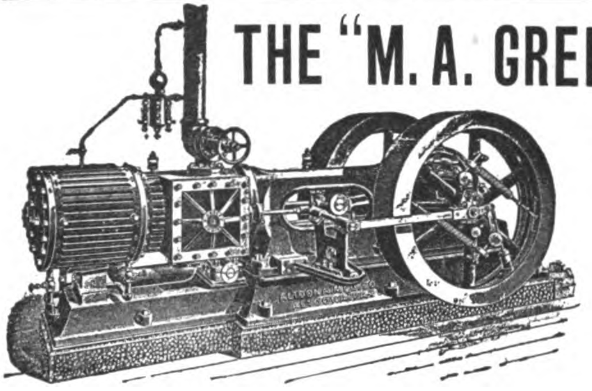

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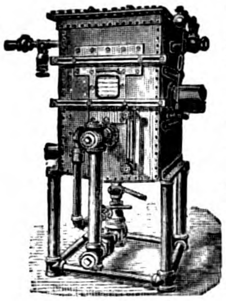

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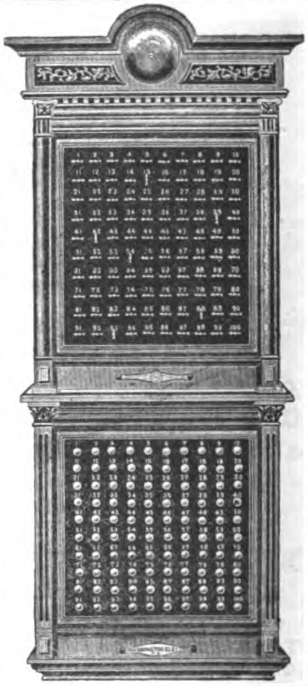

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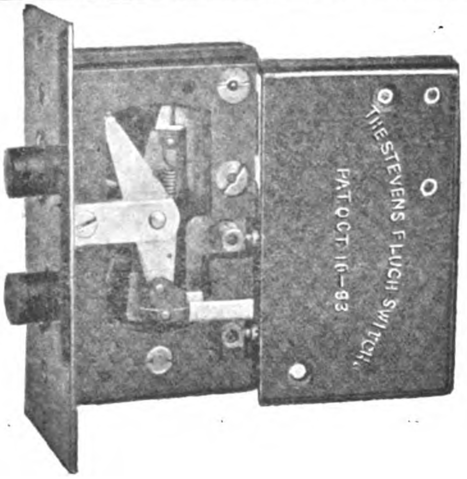

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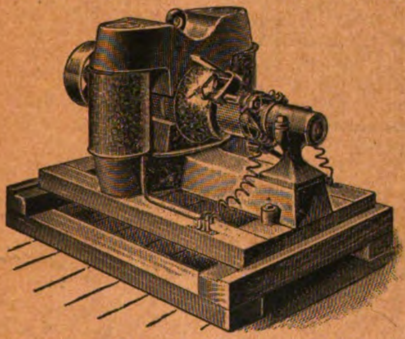

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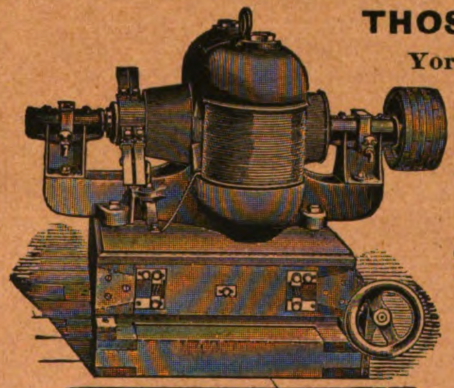

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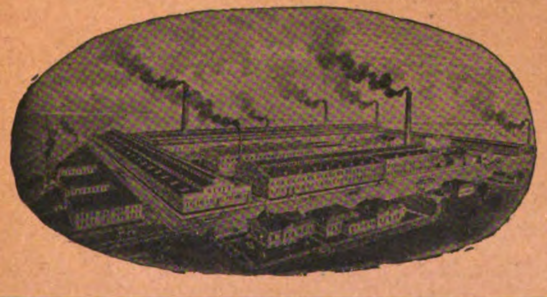

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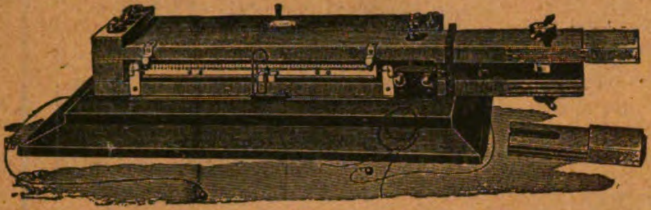

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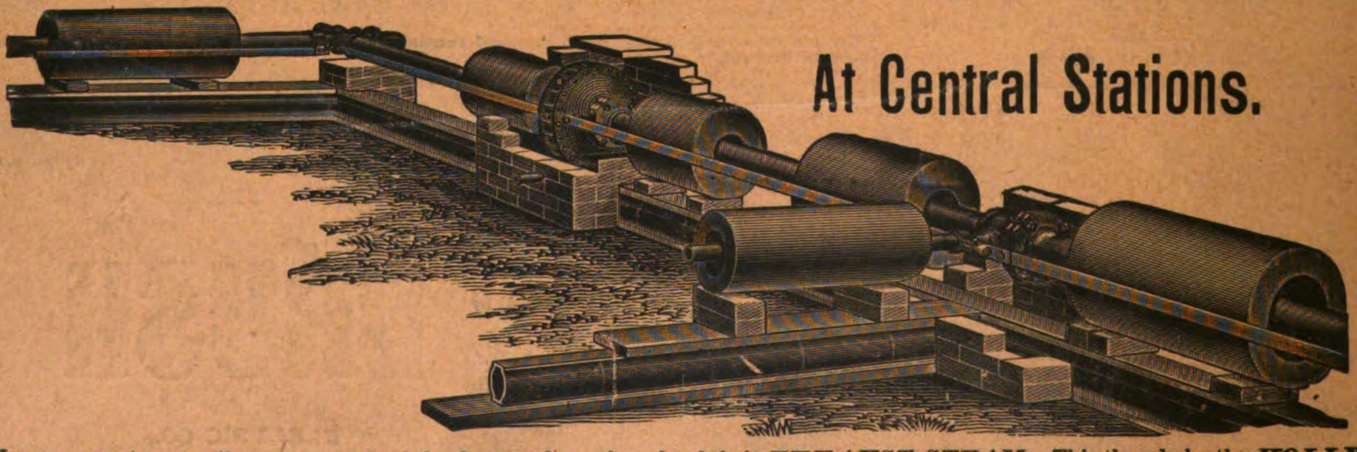

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